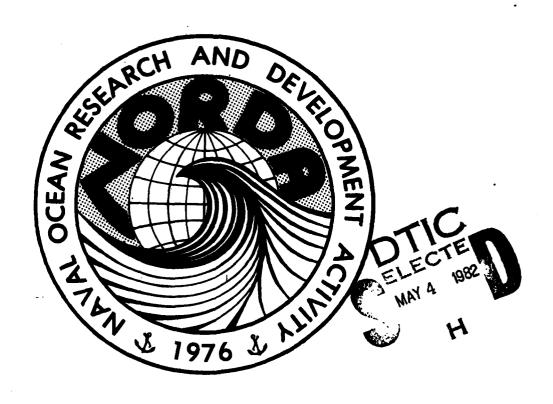
Naval Gosan Research and Development Activity NSTL Station, Mississippi 39529

Chemical, Biological and Physical Measurements from the Western Caribbean and Gulf of Mexico, Spring 1979, USNS DeSTEIGUER, Cruise 1207-79, Leg II



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DESTRIBUTION STATEMENT A

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### **EXECUTIVE SUMMARY**

This report is a summary of data collected in the Western Caribbean and Gulf of Mexico during the spring of 1979. Vertical profiles through most of the water column were obtained for the following parameters: conductivity, temperature, salinity, nephelometry, total suspended matter, dissolved and particulate organic carbon, adenosine triphosphate (ATP), chlorophyll and phaeopigments, nutrients (nitrate, ammonium, phosphate, silicate), dissolved oxygen and dissolved reduced gases (methane and nitrous oxide). Results are presented as: (1) tables of measured and dérived parameters; (2) depth profiles of unnormalized values, normalized values, and normalized rates of change. Descriptions of the collection and analytical procedures are also given.



DISTRIBUTION STATEMENT A

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### Introduction

This technical note constitutes the final data set for the first cruise of a NORDA Code 334 (Biological and Chemical Oceanography Branch) program which was undertaken in conjunction with elements of Texas AaM University to study the relationship between near-surface nepheloid (suspended particle) layers and dissolved reduced gases in the open ocean. The cruise was conducted as part of the first phase of the field program, during which we sought to (1) examine several oceanic regions to determine the generality of the occurrence of concentration maxima for the reduced gases methane (CH4) and nitrous oxide (N20) in the oxygenated, near-surface layers of the open ocean; and (2) examine a wide range of physical, chemical, and biological parameters in an effort to establish relationships with the gas distributions. The ultimate goal is to identify the in situ sources and sinks for these gases in oceanic near-surface waters.

The data are summarized in tables of the measured and derived parameters for each hydrostation. The tables are followed by depth profiles of three different treatments of the data for selected parameters. Collection and analytical procedures are detailed in Appendix B.

### Cruise Description

The program was conducted aboard the USNS DESTEIGUER Cruise 1207-79, Leg II, which departed from Rodman Naval Base, Panama, on 10 May 1979 and terminated at Gulfport, Mississippi, on 24 May 1979. Ten stations were successfully completed (see Fig. 1). Program participants and their collection and/or analytical responsibilities are listed in Appendix A.

## Station Protocol

In general, stations were taken during darkness since daylight interferes with the nephelometer sensor. The sampling package consisted of a CTD probe (Conductivity/Temperature/Depth, Neil Brown Instr., Cataumet, MA) co-mounted on a large frame with a Nephelometer (SeaMarTek, Seattle, WA) and with twelve 30 liter PVC Niskin bottles, which were tripped using an electronically controlled Rosette Sampler (frame, Niskin bottles, and rosette sampler by General Oceanics, Miami, FL). The package, standing about 2 m high and weighing almost 900 kg upon retrieval, was lowered on a single conductor, armored cable from the stern U-frame. During lowering, vertical profiles of conductivity, temperature, and nephelometry vs. depth were continuously plotted on X-Y plotters. Based on the profiles, sampling depths were chosen, the Niskin bottles raised to each desired sample depth, halted, and tripped. Once on deck, water samples were drawn from the Niskin bottles as appropriate to the lability of the parameters being measured, with gas samples being drawn first. To provide profile detail in the shallow zone, the most intense sampling was done in the upper 200 m or so; one entire cast of 12 bottles was generally tripped in this region. A second cast of 12 bottles covered the remainder of the water column.

The following parameters were measured or calculated on board: conductivity, <u>in-situ</u> temperature and pressure (all from the CTD), depth, Niskin sample salinity, nephelometry (light scattering at  $90^{\circ}$ ), nutrients ( $N0_2^-$ ,  $N0_3^-$ ,  $NH_4^+$ ,

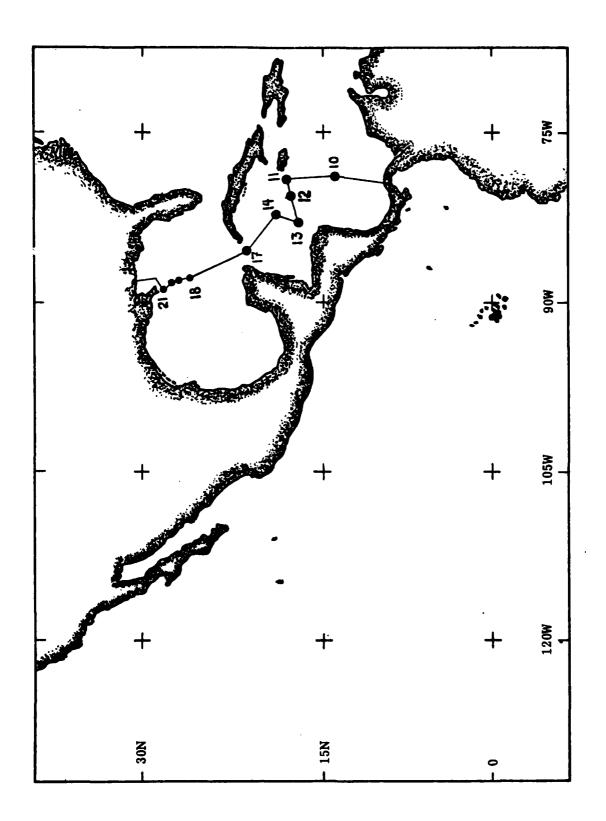


Figure 1. Cruise track, USNS DeSTEIGUER, 1207-79, Leg II

 $P04^{=}$ , Si(OH)4), and the dissolved gases 02, CH4 and N2O. The following parameters were measured or calculated from samples or data brought back to the laboratory: sigma t, total suspended matter (TSM), dissolved and particulate organic carbon (DOC AND POC), chlorophyll and phaeopigment (chlorophyll degradation product), and adenosine triphosphate (ATP, a measure of living biomass). Special collection procedures as well as the essential elements of the analytical methods may be found in Appendix B.

### Data Tables

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The data for the first 24 depths are tabulated for each station. The following comments apply:

- 1. Where a blank appears, no measurements were taken; where a zero appears, the parameter was below detectable limits.
- Nutrient, CH4 and N2O data were supplied by Dr. James Brooks, Texas A&M University. His permission to include his data here is gratefully acknowledged.
- 3. TSM samples were collected in a separate cast from the chemical data at sampling depths chosen on the basis of the continuous nephelometry trace. Thus, the TSM sample depths did not always correspond to the chemistry sample depths. In the tables, TSM values have been placed at the closest chemistry sample depths, and in most cases, they are within a few meters of their actual depths.

# 5. Table Legend:

Depth: (meters) Calculated from CTD pressure reading (from Saunders, 1981);

In Situ Temp: (degrees Celsius) Temperature from CTD reading;

Bottle Salin: (parts per thousand) Salinity of Niskin sample;

Sigma T:  $((density - 1) \times 10^3)$  Density anomaly using CTD salinity and temperature (Millero et al., 1980);

CH(4): (n1/L) Dissolved methane;

N(2)0: (n1/L) Dissolved nitrous oxide;

0(2): (m1/L) Dissolved oxygen;

TSM: (µg/liter of sea water) Total Suspended Matter (gravimetric);

Nephels: Arbitrary units of nephelometry (scattering at 90° by/ suspended particles); ANAILABILITY

POC: (ug Carbon/L) Particulate organic carbon;

DOC: (μg Carbon/L) Dissolved organic carbon;



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Total Chloro: (µg/L) Total chlorophyll "a" (chl "a");

>3 μm ATP: (ng/L) ATP of particles from 200 to 3 μm diameter;

Total ATP: (ng/L) ATP of particles 200 to 0.2 µm diameter;

NO(3): (µg-atoms/L = µM) Nitrate;

NO(2):  $(\mu g-atoms/L = \mu M)$  Nitrate;

PO(4):  $(\mu g-atoms/L = \mu M)$  Orthophosphate;

SiO(4):  $(\mu g-atoms/L = \mu M)$  Silicate;

NH(4):  $(\mu g-atoms/L = \mu M)$  Ammonium;

### Depth Profiles

The same of

As an aid to perceiving relationships among the data, depth profiles are presented for the eleven most important parameters: temperature, salinity, sigma t, chlorophyll "a", >3  $\mu m$  ATP, methane, nitrous oxide, nephelometry (or TSM), particulate and dissolved organic carbon, and dissolved oxygen. All the profiles have the same depth scale - 0 to 340 m - and the parameters are arranged to facilitate intercomparison at each depth. There are three types of profiles, each presenting a different aspect of the data:

- A. <u>Straight Data</u>. Useful for comparing magnitudes of the parameters from station to station. Parameters and their units are as in the table legend.
- B. <u>Values as % of Maximum</u>. Each parameter is normalized to its maximum value in the upper 340m for each station. These plots allow immediate identification of the depth of maximum value and facilitate comparisons among the parameters.
- C. Average Gradient, Normalized to Maximum. The change per meter was determined between two succeeding depths, was normalized to the maximum rate of change in the upper 340m, and the normalized value was plotted halfway between the depths. The gradient scale runs from -1 (maximum rate of decrease) through 0 (no change) to +1 (maximum rate of increase). (It should be noted that, since the data set consists of discrete values only, one cannot interpolate gradient values between points on this plot, only the gradient sign). These plots facilitate interparameter comparisons of gradient with depth.

DATA TABLES
USNS DESTEIGUER 1207-79
LEG II
STATIONS 10 THROUGH 21

UATA: 5/12/7J POSITION: 14.U3N; 78.95W

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4/Aeu	1.50		1.30	1.30	2.10	1.30	3.30	7.40	8.23	9.29	13.30	16.40	6.33	23.70	25.30	24.73	15.40	24.20	25.30	29,50	29.53	17.90	16.30	12.50
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depack arbit	325	336	336	357	364	299	223	156	133	123	119	129	103	112	109	113	113	116	122	ΩŞ	120	127	127	120
1	29	23	46	35	o I	2 4	30	14	17	87	19							٠		13				10
2) 0 (2) T533 2) 0 (2) T533	4.52	4.53	4.00	4.05	4.40	4.32	4.03	3.62	3.95	3.79	3.73	3.35	3. 30	2.39	2.86	2.92	3.01	3.14	, 3.30	3.66	3.33	4.25	4.03	40.4
1(2)5 ni./ii		155	147	156	115	172	181	182		103	111	272	317	457	513		€ 8.3	585	444	534	000	574	57.5	325
516:an C.1(4)	51	1.5	51	54.	6.5	£	a B	U	3 4	2	54	47	36	2.2	75	15	15	15	11		~			1
o Louis	23.372	43.410	23.536	23.304	74.111	24.359	24.706	J. 370	26.325	200,07	20.043	20.155	20.995	27.13)	11.17	21,213	27.209	:7.327	27.330	665.17	620.12	27.593	21.005	47.034
0.0% the 0.0414 0/06	30.147	10.12,	30.140	30.323	30.473	10.101	30.723	10.751	36.530	10.3.4	30.100	33.433	60.08	3,.142	112.12 020.18 811.0	1.435 \$4.034 27.213	7.2.4 54.5.4 27.20	5.40, 54.791 27.327	0.039 34.344 27.33U	5.70 54.533 21.455	850.12 115.08 ult.c	2.011 200.06 110.6	¿ 00.14. 55.45. coo.+	440.44
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110 303 25 1245 0.037 6.82  110 303 25 1245 0.036 31.19  135 345 24 1457 0.207 20.19  136 410 90 1284 0.956 90.60 1  27 244 20 1012 0.107 2.14  27 244 20 1012 0.107 2.14  27 245 0.001 0.33  27 246 20 1012 0.107 2.14  27 248 0.001 0.03  28 29 7 336 1.59  29 337 0.005 1.59  20 20 1012 0.107 2.14  21 197 9 1037 0.005 1.59  22 245 6 994 0.001 1.62  24 20 1055 0.002 0.37  25 2 4 303  27 274 6 1055 0.002 0.37  26 3 4 303  27 274 4 12  27 275 4 331  27 276 7 412  28 27 4 321  29 37 4 132  20 20 30 30 30 30 30 30 30 30 30 30 30 30 30	310.10 CH(4)	٦(٦)٥	0 (2)	T.S.M.	Nepnet	P.C.	, ,	Fotak Totak	×3 u.a	Potab	40(3)	30(2)	FO (4)	SiO(4)	33 (4)
110   303   25   1245   0.036   31.19   29.76   0.00   0.00     115   345   24   1457   0.207   20.19   30.17   1.00   0.00     150   410   90   1284   0.956   90.60   140.07   1.00   0.130     150   410   90   1284   0.956   90.60   140.07   1.00   0.130     150   410   90   1284   0.956   90.60   140.07   1.00   0.130     151   244   20   1012   0.107   2.14   17.10   3.10   0.130     152   244   20   1012   0.107   2.14   17.10   3.10   0.130     153   174   9   397   0.005   0.37   2.77   5.60   0.140     245   7   932   0.001   0.33   7.26   15.90   0.130     256   7   932   0.002   0.47   1.62   1.05   10.40     257   6   994   0.001   1.62   1.05   10.40   1.30     258   7   942   2.001   1.62   1.05   10.40   1.20     250   7   942   2.00   1.25   2.10   1.20   1.20     250   7   942   2.00   1.25   2.10   1.20   1.20     250   7   943   2.00   2.47   1.25   2.30   1.20     250   7   943   3.10   0.70   3.73   2.50   1.10     250   7   412   2.00   2.00   2.40   1.10   1.20     250   7   411   2.00   3.73   2.50   1.10     250   7   411   2.00   3.73   2.50   1.10     250   7   431   3.21   3.30   1.20   1.10     250   7   431   3.30   3.40   1.20   1.10     250   7   431   3.30   3.40   1.20   1.10     250   7   431   3.30   3.40   1.20   1.10     250   7   431   3.30   3.40   1.20   3.30     250   7   431   3.30   3.40   1.20   3.30     250   7   431   3.30   3.40   3.40   1.30   3.30     250   7   9.30   9.40   9.40   1.70   3.40   1.40   1.40     250   7   9.30   9.40   9.40   9.40   1.40   1.40   1.40     250   7   9.40   9.40   9.40   9.40   9.40   9.40     250   7   9.40   9.40   9.40   9.40   9.40   9.40   9.40     250   7   9.40   9.40   9.40   9.40   9.40   9.40   9.40     250   7   9.40   9.40   9.40   9.40   9.40   9.40   9.40     250   7   9.40   9.40   9.40   9.40   9.40   9.40   9.40     250   7   9.40   9.4	(a) 1 c) C o/00 (a) 1 c) C o/00 	חני/ף	ī			ugc/L		ug/t	7	ng/L	ugA/L	ug3/L	2/5(u		ugh/L
110   303   25   1245   0.036   31.19   29.76   0.00   0.20     115   345   24   1457   0.207   20.19   30.17   1.00   0.40     150   410   90   1284   0.956   90.60   140.07   1.00   0.10     49   268   19   10.21   0.056   7.90   15.52   5.40   0.10     17   244   20   10.12   0.105   7.90   15.52   5.40   0.10     18   174   9   30.7   0.005   1.59   2.77   5.60   0.10     19   246   7   932   0.001   0.33   7.26   15.50   0.10     19   262   7   932   0.001   1.62   1.05   1.00   1.20     246   7   932   0.002   0.37   1.51   23.10   1.20     250   7   942   1.62   1.62   1.65   1.640   1.30     270   5   850   7   942   1.21   23.10   1.20   1.20     270   7   337   7   2.31   1.26   25.30   1.70   1.20     270   7   337   7   2.31   1.38   2.30   1.70   1.20     270   7   313   7   2.14   2.630   1.70   1.20     270   7   412   7   4.03   7   2.41   2.630   1.70   1.20     270   7   412   7   2.00   3.73   2.130   1.70   1.20     270   7   412   7   4.03   7   7   7   7   7   7     270   7   412   7   7   7   7   7   7   7     270   7   412   7   4.03   7   7   7   7     270   7   412   7   7   7   7   7   7     270   7   412   7   7   7   7   7     270   7   412   7   7   7   7   7     270   7   7   7   7   7   7   7     270   7   7   7   7   7   7   7     270   7   7   7   7   7   7   7     270   7   7   7   7   7   7   7     270   7   7   7   7   7   7   7     270   7   7   7   7   7   7     270   7   7   7   7   7   7   7     270   7   7   7   7   7   7     270   7   7   7   7   7   7     270   7   7   7   7   7   7     270   7   7   7   7   7     270   7   7   7   7   7     270   7   7   7   7   7     270   7   7   7   7   7     270   7   7   7   7   7     270   7   7   7   7   7     270   7   7   7   7   7     270   7   7   7   7   7     270   7   7   7   7   7     270   7   7   7   7   7     270   7   7   7   7   7     270   7   7   7   7   7     270   7   7   7   7   7     270   7   7   7   7     270   7   7   7   7     270   7   7   7   7     270   7   7   7   7     270   7   7   7   7     270					405	40	1394	0.037	6.82	17.39	1.03		0.40	1.30	
135   345   24   1457   0.207   20.19   30.17   1.00   0.40     150   410   90   1284   0.956   90.60   140.07   1.00   0.130     49   268   19   1071   0.066   7.90   15.52   5.40   0.130     17   24   20   1012   0.107   2.14   17.10   3.10   0.130     18   174   9   397   0.005   1.39   2.77   5.60   0.40     19   174   9   397   0.005   0.37   5.60   0.40     15   174   9   397   0.005   0.37   5.60   0.40     246   7   932   0.001   0.33   7.26   15.90   1.20     246   7   932   0.001   0.33   7.26   15.90   1.20     246   7   942   7   4.07   1.52   23.10   1.64     270   7   843   7   2.30   16.40   1.20   1.20     250   4   303   7   2.30   16.40   1.20   1.20     250   4   303   7   2.30   16.40   1.20   1.20     250   4   303   7   3.47   2.30   1.20   1.20     260   7   412   7   1.26   2.30   1.20   1.20     260   7   412   7   1.30   1.20   1.20     260   7   412   7   1.30   1.20   1.20     260   7   412   7   1.30   1.20   1.20     260   7   412   7   1.30   1.20   1.20     260   7   8   3.21   1.20   1.20   1.20     260   7   412   7   1.20   1.20   1.20     260   7   412   7   1.20   1.20   1.20     260   7   412   7   1.20   1.20   1.20     260   7   8   3.21   7   1.20   1.20     260				110	303	25	1245	0.036	31.19	29.76	0.00		0.23	06.0	
150   410   90   1284   0.956   90.60   140.07   1.00   0.30     49   336   31   1233   0.346   17.96   42.46   1.30   0.15.2     27   244   20   1012   0.1107   2.14   17.10   3.10   0.120     17   197   9   1037   0.016   7.90   15.52   5.40   0.130     18   174   9   1037   0.005   1.39   2.77   5.60   0.40     19   248   6   994   0.001   0.33   7.26   15.90   1.30     27   248   6   994   0.001   1.62   1.05   16.40   1.30     270   7   942   7   2.30   1.51   23.10   1.20     270   7   843   7   2.30   16.40   1.20     270   7   837   7   2.30   16.40   1.20     270   8   303   7   2.30   16.30   1.20     270   7   412   7   1.35   2.50   1.20     270   7   412   7   1.30   2.70   1.20     270   7   412   7   1.30   2.70   1.20     270   7   412   7   1.30   1.20   1.20     270   7   412   7   1.30   1.20   1.20     270   7   412   7   1.30   1.20   1.20     270   7   412   7   1.30   1.20   1.20     270   7   412   7   1.30   1.20   1.20     270   7   412   7   1.30   1.20   1.20     270   7   412   7   1.30   1.20   1.20     270   7   412   7   1.30   1.20   1.20     270   7   412   7   1.30   1.20   1.20     270   7   412   7   1.30   1.20   1.20     270   7   412   7   1.30   1.20     270   7   412   7   1.30   1.20   1.20     270   7   412   7   1.30   1.30     270   7   270   7   270   1.20     270   7   270   7   270   1.20     270   7   270   7   270   1.20     270   7   270   7   270   1.20     270   7   270   7   270   1.20     270   7   270   7   270   1.20     270   7   270   7   270   1.20     270   7   270   7   270   1.20     270   7   270   7   270   1.20     270   7   270   7   270   1.20     270   7   270   7   270   1.20     270   7   270   7   270   1.20     270   7   270   7   270   1.20     270   7   270   7   270   1.20     270   7   270   7   270   1.20     270   7   270   7   270     270   7   270   7   270     270   7   270   7   270     270   7   270   7   270     270   7   270   7   270     270   7   270   7   270     270   270   270   270     270   270   270   270     270				135	345	P.7	1457	0.207	20.19	30.17	1.00		0.43	1.30	
49         336         31         1233         0.346         17.96         47.36         1.30         0.113           49         268         19         1071         0.069         7.90         15.52         5.40         0.50           27         244         20         1012         0.137         2.14         17.10         3.10         0.130           15         174         9         397         0.005         1.59         4.12         0.130           296         7         932         0.001         0.33         7.26         15.90         0.130           245         6         996         0.002         0.47         1.62         15.90         1.20           270         7         942         0.002         0.47         1.51         23.10         1.20           270         7         942         0.002         0.47         1.51         23.10         1.20           270         7         942         1.62         1.05         1.05         1.00         1.20           270         7         942         1.62         1.62         2.31         1.00         1.00           270         4 <th< td=""><td></td><td>101</td><td></td><td>150</td><td>410</td><td>0.6</td><td>1284</td><td>0.956</td><td></td><td>140.07</td><td>1.00</td><td></td><td>٠٤ ، ي</td><td>0.00</td><td></td></th<>		101		150	410	0.6	1284	0.956		140.07	1.00		٠٤ ، ي	0.00	
49         268         19         1071         0.069         7.90         15.52         5.40         0.120           27         244         20         1012         0.107         2.14         17.10         3.10         0.130           17         197         9         1037         0.016         1.59         4.12         0.130           18         174         9         1037         0.001         0.34         4.10         1.20         0.130           265         7         942         0.001         1.62         1.640         1.20         1.20         1.20           266         7         942         1.62         1.62         1.640         1.20		•		76	336	31	1233		17.98	42.36	1.30		3.13	0.40	
27         244         20         1012         9.134         17.14         3.19         4.13         0.33           17         197         9         1037         0.005         1.59         4.13         0.33           15         174         9         397         0.005         1.59         1.15         0.40         0.33           296         7         932         0.001         0.33         7.26         15.60         0.43           274         6         1055         0.001         1.62         1.05         1.20         1.20           262         7         942         0.001         1.62         1.05         1.20         1.20           274         6         1055         0.002         0.47         1.51         23.10         1.20           279         7         942         7         4.07         15.00         1.20         1.20           270         7         942         7         4.07         15.00         1.20         1.20           270         7         93         7         2.30         1.23         1.20         1.20           271         7         43         7 <td< td=""><td></td><td></td><td></td><td>49</td><td>268</td><td>19</td><td>101</td><td>0.060</td><td>7.90</td><td>15.52</td><td>5.40</td><td></td><td>9.39</td><td>2.03</td><td></td></td<>				49	268	19	101	0.060	7.90	15.52	5.40		9.39	2.03	
15 174 9 1037 0.016 3.99 1.13 0.13 0.13 1.20 0.13 1.20 1.24 2.96 7 9 39.7 0.005 1.59 2.77 5.60 0.43 1.20 1.20 1.20 1.20 1.20 1.24 6 994 0.001 1.62 1.61 1.61 1.61 1.62 1.63 1.63 1.20 1.20 1.23 1.24 6 1055 0.002 0.47 1.51 23.10 1.23 1.24 1.25 1.25 1.25 1.63 1.24 1.25 1.25 1.25 1.25 1.25 1.25 1.25 1.25				27	244	70	1012	9.137	2.14	17.10	3.10		in □ □	u.3u	
15       174       9       397       0.005       1.59       2.77       5.60       0.430         296       7       932       0.001       0.33       7.26       15.50       1.20         245       6       994       0.001       1.62       1.05       16.40       1.30         274       6       1055       0.002       0.47       1.51       23.10       1.30         262       7       942       7       4.07       15.00       1.30         270       5       853       7       2.04       16.40       1.24         270       7       837       7       2.04       16.30       1.20         273       4       336       7       2.47       26.30       1.20         274       4       343       7       2.47       26.30       1.70         275       7       412       7       4.12       7       4.12       1.32       1.73         274       4       3.21       0.70       3.73       21.20       1.70       1.70         290       5       3.64       3.24       1.01       1.01       1.01       1.01	, ,	6.67		17	197	27	1037	0.016		3.90	4.10		ى3،	1,30	
246       7       932       0.001       0.33       7.26       15.90       1.20         245       6       1055       0.002       0.47       1.61       23.10       1.30         262       7       942       4.07       1.51       23.10       1.51         270       7       942       7       4.07       15.00       1.20         270       7       437       7       2.30       16.40       1.20         270       7       437       2.30       16.40       1.20         205       4       3.03       0.21       1.26       25.30       1.20         273       4       3.36       1.36       2.47       26.30       1.70         274       4       3.21       0.70       3.37       22.60       1.70         274       4       3.21       0.70       3.73       21.20       1.70         275       7       4.32       0.70       12.40       1.70         274       4       3.21       0.70       12.40       1.70         290       5       3.64       1.01       1.76       7.40         200       1.70 <t< td=""><td></td><td></td><td></td><td>15</td><td>174</td><td>σ</td><td>397</td><td>0.005</td><td>1.59</td><td>2.17</td><td>5.60</td><td></td><td>0.40</td><td>1.73</td><td></td></t<>				15	174	σ	397	0.005	1.59	2.17	5.60		0.40	1.73	
245         6         994         0.001         1.62         1.05         23.10         1.53           262         7         942         4.07         1.51         23.10         1.53           270         5         850         7         2.30         16.40         11.33           270         7         942         7         2.30         16.40         11.33           270         7         943         7         2.30         16.40         11.28           265         4         403         0.21         1.26         25.30         11.20           273         4         436         7         2.47         2.43         2.49           276         7         412         7         3.47         2.63         1.70           274         4         3.21         0.70         3.73         21.20         1.70           290         5         3.64         1.01         2.40         1.40         1.40           300         6         7         4.1         0.70         3.73         1.40         1.40           290         5         3.64         1.01         2.40         1.40         1.40 <td>•</td> <td></td> <td></td> <td></td> <td>536</td> <td>7</td> <td>932</td> <td>0.001</td> <td>0.33</td> <td>7.26</td> <td>15.90</td> <td></td> <td>1.20</td> <td>6.39</td> <td></td>	•				536	7	932	0.001	0.33	7.26	15.90		1.20	6.39	
262         7         942         4.07         15.10         1.33           262         7         942         4.07         15.00         1.33           270         5         850         7         2.30         16.40         1.24           270         7         437         7         2.04         16.50         1.24           205         4         303         0.21         1.26         25.30         1.20           273         4         336         7         2.47         26.30         2.03           206         7         412         7         412         7         3.37         22.60         1.70           208         7         431         0.70         3.73         21.20         1.70           208         7         431         0.70         3.73         21.40         1.70           209         267         0.267         1.00         1.00         1.00         1.00           290         3         3.54         1.01         23.40         1.00         1.00           290         3         3.33         3.33         0.40         1.76         7.40	4	1 9		•	245	٠.	29.90	u.001	1.62	1.05	16.40		1.30	6.73	
262       7       942       4.07       15.00       11.30         270       5       850       2.30       16.40       11.20         270       7       837       2.08       16.50       11.20         205       4       303       0.21       1.26       25.30       11.20         273       4       336       2.47       26.30       2.00         206       5       401       1.38       23.90       2.00         206       7       412       3.37       22.60       1.70         207       7       412       0.70       3.73       21.20       1.70         208       7       431       0.70       3.73       21.40       1.70         200       250       267       1.01       70       50         290       3       338       0.40       1.76       70         230       3       338       0.40       1.76       70         30.0       3       338       0.40       1.76       70	4	33			274	9	1055	0.002	66.0	1.51	23.10		1.0.1	15.70	
270       5       850       2.30       16.40       1.24         205       4       503       0.21       1.26       25.30       1.50         273       4       336       2.47       26.30       2.03         261       8       301       1.38       20.50       2.03         269       7       431       0.70       3.73       21.20       1.70         274       4       321       2.00       12.40       1.10         290       5       364       1.61       23.40       1.91         230       3       333       3.34       1.61       23.40       1.40					262	7	942			4.07	15.00		1.33	7.23	
265       4       303       0.21       1.26       25.30       1.29         273       4       336       2.47       26.30       2.03         201       6       301       1.38       23.90       2.03         204       6       301       1.38       23.90       2.03         205       7       412       3.37       22.60       1.70         204       4       321       0.70       3.73       21.20       1.70         202       0       267       0.07       7.00       12.40       1.10         200       250       3.54       1.01       23.40       1.40         200       3       333       3.34       0.40       1.76       7.40	7	4			270	in	850			2.30	16.40		1.24	0.23	
265         4         503         0.21         1.26         25.30         1.50           273         4         336         2.47         26.30         2.00           261         8         301         1.38         20.90         2.00           269         7         431         0.70         3.73         21.20         1.70           274         4         321         2.00         12.40         1.10           290         5         364         1.61         23.40         1.40           230         3         333         3.34         1.61         23.40         1.40					270	7	837			2.08	16.30		1	3.33	
273         4         336         2.47         26.30         2.20           201         6         301         1.38         23.90         2.23           269         7         412         3.37         22.60         1.70           269         7         431         0.70         3.73         21.20         1.70           274         4         321         2.00         12.40         1.70           290         5         364         1.01         23.40         1.40           240         3         333         3.40         1.76         7.40	•	ęρ			205	7	303		0.21	1.26	25.33		1.40	113	
261       6       301       1.38       23.90       2.39         269       7       431       0.70       3.73       21.30       1.70         274       4       3.21       2.00       12.40       1.70         252       0       267       0.27       1.00       1.30         290       5       3.44       1.01       23.40       1.40         230       3       333       0.40       1.76       7.40					273	•	336			2.47			2.00	24.13	
269     7     412     3.37     22.69     1.70       269     7     431     0.70     3.73     21.29     1.70       274     4     321     2.00     12.40     1.70       232     0     267     0.27     1.00     12.40     1.30       290     5     354     1.61     23.40     1.43       240     3     333     0.40     1.76     7.40     0.53					261	œ	101			1.38	23.90		2.33	£J.	
269     7     431     0.70     3.73     21.20     1.70       274     4     321     2.00     12.40     1.30       242     0.57     70     70       290.     5     364     1.61     23.40     1.40       240     3     333     0.40     1.76     7.40     0.51		533			276	7	412			3.37	22.69			13.43	
232 v 267 0.57 7.0 5.0 5.0 260 2.40 1.76 7.40 5.00 2.40 1.76 7.40 5.00 5.00 5.00 5.40 5.40 5.40 5.00 5.0					269	7	131		0.70	3.73	21.20		1.10	15.43	
290. 5 364 0.07 7.00 7.00 290. 2 364 1.01 23.40 1.40 2 2 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3		407			274	4	3.21			2.00	12.40		١. ي	.6.6	
290. 5 364 1.01 23.40 1.40 2.60 3 333 0.40 1.76 7.40 0.50		395			232	,	797			75.0	61			5.40	
3 338 0.40 1.76 7.40 0.50		144			290.		364			1.01	23.40		1.43	23.70	
					230	~	333		3.40	1.76	7.40		3.5	i.33	

AND 2016/10 POSITION: 18.914; 82.188

3.3 (4) 6.3 Å/5																								
4) (4) (1) (1) (1) (1) (1) (1) (1) (1) (1) (1	1.73	3.50	0.10	1.50	1.7.	5.73	ن.ن د ن ن	1.1	ر. ن ر.	1.7.	1.30	1.36	4.33	0.16	J 3. ÷U	17.30	) (1)	3000	30.6		54.6.	14.00	٠ ن ن	17.73
0 (t) (a 0 (t) (a) (a) (a) (a) (a) (a) (a) (a) (a) (a	ن. 3 ک	٠٤٠٠	0.10	(.5.0	ن. ئ	.1.	. J.	1.20	?	,	0.33	9	· · ·	:	;		4.3.	. 1 • 1	1.10	1. ; 0	2.000	:		1.75
3.5(2) ug3/E																								
30(3) 1	1.30	1.03	0.33	1.03	1.3	1.30	1.03	1.50	2.10	J	J. ö.	3.50	11.10	17.50	25.00	6.7.3∪	30.05	Uč.72	14.20	3.23	43.70	21.30	21.30	21.13
TOESM ATE ng/L	34.72	17.96	24.77	14.38	20.77	22.49	25.11	7.69	4.17	8.31	3.33	1.07	5.52	2.00	2.12		4.32	2.05	1.40	1.35	1.74	1.27	1.12	1.16
>3 un ATP ng/L	21.73	11.11	7.21		15.35	2.03	3.56	3.93	2.73	1.49		0.27								0.37				0.35
Totai Chroro ug/L	0.024	0.021	0.035	0.047	0.059	ა. 166	J.174	0.103	0.023	0.014	0.003	ú. uu 1												
2 200 2 2/264	621	013	730	627	0+0	522	546	476	499	432	369	307	177	326	137	206	212	201	200	331	777	733	331	268
POC ugC/L	3 i	59	52	57	19	25	21	==	'n	Þ	S	9	10	ສ	6	1.0	()	2	G,	~	5	7	9	~
depneu arbit	9	159	172	193	164	175	157	119	4	R R	6.5	ć.	135	113	127	122	126	113	131	127	126	170	119	116
13.01 1/Eu		39		31		34	21			a								•						
0(2)	40.4	4.02	9°.4	4.70	4.75	4.06	4.19	4.43	4.01	3.78	3.07	3.01	3.31	3.33	2 s	ۇن.2	2.30	2.93	3.11	3.37	3.06	3.94	4.77	5.12
ر(2) ع/با	155	215			251	194		177	175	202	247	326		413	335	÷ 0.0		(;;	512	10.	ئ ق	81.5	414	398
Ca(4)	55	51	55	٠1	ŝ	ĵĵ	żċ	33	20	95	95	7.2	5 5	7	11	70	1.1	0.1	÷ 1	7	1.0			7
310 th 0.1(4)	23.340	23.338	23.390	23.369	23.033	13.377	23.733	44.251	24.305	123	0,00.07	20.320	610.07	102	(10.12	001.12	27.213	207.17	118.12	61.3.5	21.412	21.143	2115	17.721
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1	£ 0.1.02	54.173	+12.00	\$51.05	30.1.0	ىدۇ.بۇ	15.371	θι #•υξ	30.300	33.300	733	51.343	13.35.	23.753	21.21	outils trovic free	612.75 USC. 56 C O	1.2 3 3 3 21.202	116.12 1.6.15 27.317	0.1. 3 31. 21.312	5.111 31.151 21.412	5	4.016 St. 146 21.013	4.503 51.555 27.729
ours. Assiss coffed 3163A Ca(4) 15.45 calls f nazh n	27.53 20.103 23.340	17 27.000 50.170 23.330	3 1 27.17. 30.214 23.390	40 27.154 So.154 23.309	20.112 30.150 23.093	71 20.520 Ju. 350 23.377	11. 20.27 15.371 23.23	157.12 60.406 027.62 101	1 . 24.172 30.300 24.305	50.02 wester rates 20.007	20 20.733 20.006	64- 10-422 53.343 64.360	15. 15. 15. 15. 15. 28.013	162	¿ \$ 0.15	6	:	1	9.00	•		j. , ć	:	4.503
(1)	7	11	3	.;	1,	7,	7	101	-	7.7	-	, ,		• :	111		; 7/	:;;	:	;	;	111	11.7	•

SIN 17 SIN 1700 SIN 17 SIN 17

THE PARTY OF THE PROPERTY OF THE PARTY OF TH

POSITION: 21.71N; 85.59W

DAYE: 5/20/79

ää (4)	USA/L	_																							
PO(4) S10(4)	1/V	06.1	1.73	1.90	1.50	1.90	Co.5	1.73	1.70	1.99	2.20	3.60	5.63	4.50	£.30	10.00	13.76	7	16.50	19.50	20.20	24.60	.i.33	14.4	4
FO(4)	ng\/L	0.50	0.40	0.40	0.26	0.30	0.20	0.50	0.50	ე. 5ს	6.63	0.70	1.10	3.5	1.40	1.60	1.50	1.90	2.10	23	2.20	. 4.0	1.50	1.70	.4.0
30(2)	uga/L	-																							
NO (3)	ugA/L	1.30	1.00	1.00	0.30	1.00	0.30	3.60	4.40	4.96	6.20	8.20	14.40	11.10	18.40	22.10	26.10	20.10	27.90	30.50	29.50	31,33	25.00	20.50	18.70
Total	ng/t-	12.94	16.86	15.23	10.30	18.62	32,44	23.18	10.13	20.18	9.75	19.76	1.70	6.67	,. 3ù	.41	0.22	0.75	0.19	0.18	0.34	0.32		0.38	1.18
73 c.m	ng/L	3.13	19.93	5.40	7.50	9.00	4.82	3.31	2.48	1.73	1.92	0.45	0.51								0.40				0.51
rotal,	19/En	0.032	0.050	0.051	0.078	0.143	0.112	0.051	0.012	0.002		0.001													
200	ugc/L	1016	916	863	1048	851	631	617	656	759	626	862	659	306	953	619	099	837	833	959	599	683	850	194	703
200	ugC/L	33	33	30	56	23	25	70	11	13	10	12	14	35	28	8.4	12	18	27	12	13	12	11	12	19
Hephel	arbit					141	281	203	177	150	129	123	119	137	124	120	125	136	129	128	126	134	123	116	114
HS.	ug/L	-																							
0(2)	7/T	4.63	4.79	4.81	4.79	4.78	4.51	4.00	3.95	3.94	3.99	3.97.	3.54	3.33	3.27	3.00	2.94	2.90	2.89	2.93	3.06	3.40	3.86	5.61	5.71
N(2)0	7772	147	133	133	133	162	157	181	262	218	221	294	271	354	475	504	350	523	457	485	535	434	464	338	301
Ch (4)	nu/L	. 13	55	62	62	58	de	8	82	7.9	83	58	55	4 3	41	8	36	31	27	77	21	17			
SIGNA CH(4	.	23.393	23.611	23.718	23.804	23.958	24.244	24.866	25.473	25.754	26.196	26.391	26.644	26.790	20.493	26.997	27.066	27.127	27.163	27.215	27.270	27.405	27.523	27.755	627.72
DEPTH LIGHTO BOTTLE	(a) leg c u/ou nu/L	-0 27.735 36.201 23.393	53 27.017 36.103 23.611	07 20.661 36.174 23.718	83 20.410 36.182 23.804	96 25.957 36.198 23.958	125 25.742 30.504 24.244	149 24.370 36.755 24.866	174 22.572 36.858 25.473	196 21.503 36.830 25.754	240 19.359 36.052 20.190	294 fo.176 30.513 25.391	30.4 15.556 36.002 26.644	430 14.359 35.876 26.790	474 13.123 35.6cz 20.493	139 11.606 35.426 26.997	509 16.556 35.268 27.066	5.631 35.142 27.127	8.925 35.041 27.163	0.004 34.940 27.215	7.312 34.876 27.270	6.172 34.040 27.405	5.510 34.864 27.523	4.139 34.979 27.755	4.117 34.982 27.759
Linkto	1 eg C	27.135	710.72	20.661	20.410	756.57	25.742	24.370	22.572	21.503	45.359	16.170	15.556	14.359	13.123	11.606	16.556	5.631		400.0	7.312	6.172	5.54v	4.139	4.117
มละสาด	(3)	· ?	5.3	. 70	83	96	125	. 5 + [	174	196	246	200	30.3		./.	28.0	800	22.0	.5	732	661	070	404	1932	4061

USec 1207-79 SER 18

87.71W	
26.02N;	
POSTITION:	
61/27/5	
DA's E:	

NO(3) NO(2) PO(4) SiO(4) NA(4)	uga/L uga/L uça/L uça/L usa/L												
iw)(2) FO(4	1/49u 1/kgu												
	ng/L ugA/L	•										,	
>3um	ng/t					•							
DOC Total	arbit ugC/L ugC/L ug/L	0.034	0. U39	0.054	0.070	0.115	0.134	0.199	0.079	0.047	0.019	0.610	900 0
30 <i>a</i> -1	ugC/L ug		20	2	· o	,	_	va.	0	-	9	9	
	ug/L arbit	138	208	202	961	217	201	196	130	101	90	103	17
N(2)0 0(2) TSE	m1/L			Ŋ	4	4	9	4	<b></b>		55	نت	•
	101./L	2 158	7	7 152	9 134	7 164	2 166	6 134	נדנ ו	-	1 249	2 349	47 354
Cii (4)	17.72	42	•	47	49	4	52	99	11	1.1	17	52	
SIGH	.	23.370	23,351	23.395	23.674	23.885	23.965	24.044	24.345	25.043	25.943	26.32	20.663
Crite	37	36.079	36.001	36.124	30.252	36.074	36.160	36.256	36.400	36.761	36.708	36.185	36.117
Erra Italfo ocrand Slone Ch(4)	1 e y C u/vu	1 27.523 36.079 23.370	20 27.540 36.001 23.351	38 27.549 36.124 23.395	70 26.983 30.252 23.674	94 25.052 36.074 23.885	104 25.030 36.163 23.969	120 25.022 36.256 24.044	147 25.398 36.400 24.345	170 23.776 30.751 25.043	245 20.444 36.768 25.943	370 16.302 56.185 26.552	460 15.75g 36.117 28.663
LEPin	(E)	7	20	38	2.5	λ 4	104	120	147	176	5÷7	370	410

USind 1207-79 STATESTER ST

OAFE: 5/22/79 POSITION: 26.84N; 88.03W

DAFR INSIED DOFFEE SIGNA CH(4)	STATE OF	SIGNA	Ch (4)	N(2)0	0(2)	TSM	N(2)0 0(2) TSM Wephel-	<b>20%</b>	200	Total	>3cm	Total.		10(2)	PO(4)	NO(3) NO(2) PO(4) SIO(4) NH(4)	NH (4)
(m) leg C u/00 nu/L	1eg c 0/00	, <u> </u>	Pit/L		17/E	ng/L	ug/L arbit ugC/L ugC/L ug/L	ngC/L	ugc/L			ng/L	ng/L ugà/L ugà/L			ugà/L ugA/L ugA/L	ug Ni
1 27.59	1 27.599 36.231 23.460	23.460	47			46	129			0.026		29.49	1.00			1.70	
16 27.50	16 27.509 36.226 23.461	23.461	57	184			165			0.028	2.65	4.35	1.00		0.20	1.30	
41 27.59	41 27.590 36.234 23.465	23.465	19	178		37	164			0.023	7.20	14.75	1.00		0.30	1.50	
62 26.49	62 26.499 36.254 23.703	23.703	57	. 203			189			0.055	7.91	10.42	1.20		0.30	1.70	
84 26.11	84 26.116 36.143 23.867	23.867	55	192			182			0.071	86.98	10.30	0.70		0.10	3.60	
107 25.655 36.421 24.211	5 36.421	24.211	63	163		35	211			0.230	12.43	33.82	1.00		0.30	1.50	
124 24.716 36.716 24.732	6 36.716	24.732	08	205			142	•		0.108	9.17	15,31	2.60		C fr a	1.50	
146 23.640 36.826 25.126	U 36.826	25.126	98	234		19	109			0.064	0.75	13.92	1.40		0.16	09.0	
184 21.771 36.654 25.697	1 36.054	25.697	74	218			30			0.013	09.0	5.52	4.30		0.40	1.75	
2JU 20.537 36.770 25.973	7 36.770	25.973	7.0	231		19	30			0.008	1.77	10.57	3.30		6.33	1.20	
306 16.884 36.303 26.549	4 36.303	26.549	59	351			72	•		0.001	0.74	12.28	6.70		0.40	2.10	
41d 13.367 35.706 26.867	7 35.706	20.667	43	432		17	70			0.001	0.49	3.64	16.20		0.10	7.30	

SIN 20 SIN 1207-79

DATE: 5/23/79 POSITION: 27.55N; 64.30W

	i (4)	7												
	RO(3) RO(2) PO(4) SIO(4) SH(4)	uga/L uga/L uga/L uga/L uga/L	1.20	0.50	1.50	1.50	3.50	6.43	3.70	3.60	, c.	30.0		0.00
	, i.i.	3												1.50 16.00
	PO (4	45/12		0.33	0.40	0.3	3.70	3. 3.	0.70	0.70	0.90	1.00		1.5
	80(2)	ngy/r												
		uÿA/L	1.40	1.00	1.20	2.40	10.70	12.19	10.00	10.00	12.10	13.30		20.20
	Total.	4/50					•							
		7/Fu												
	OC Total	7/5n	0.067	0.088	0.123	0.642	0.421	0.068	0.046	0.012	0.005	0.003		0.002
	၁၀၀	1/25n												
	Poc	ugC/L												
	Mephol	ni./L ml/L ug/L arbit ugC/L ugC/L ugC/L	200	200	238	327	569	143	139	134	112	97	103	89
		ug/L	•											
	N(2)0 0(2) TSM	A/L	-											
	к(2) o	nt./L	173	205	220	241	282	389	527	398	386	382		
	Cii (4)	nis/1-	9	30	3	32	8.2	74	55	55	40	45		45
	SICAR	.	24.254	24.447	25.534	25.915	26.057	26.344	26.470	26.591	26.714	20.732	20.706	26.911
	DEPTH LUSITO DOTTED SIGAR Ch(4)	(E) 163 (V)00 nh/L	1 24.794 36.110 24.254	21 24.067 36.320 24.447	42 21.161 36.424 25.534	od 19.725 36.411 25.915	76 19.294 30.449 26.057	102 17.930 36.372 26.344	116 17.205 36.305 26.470	142 10.215 36.157 26.591	174 15.185 36.012 26.714	154 14.406 35.950 20.732	152 14.515 35.883 20.706	25. 12.960 35.656 26.911
	Lastro	(E) 169 C L/UU	24.794	24.007	21.161	19.725	19.294	17.930	17.205	10.215	15.185	14.406	415.41	12.960
•	ber'su	(H)	-	21	42	3	16	102	116	747	174	104	771	23.0

Sin 21 Sin 1207~79

DATE: 5/23/79 POSITION: 28.24H; 88.77W

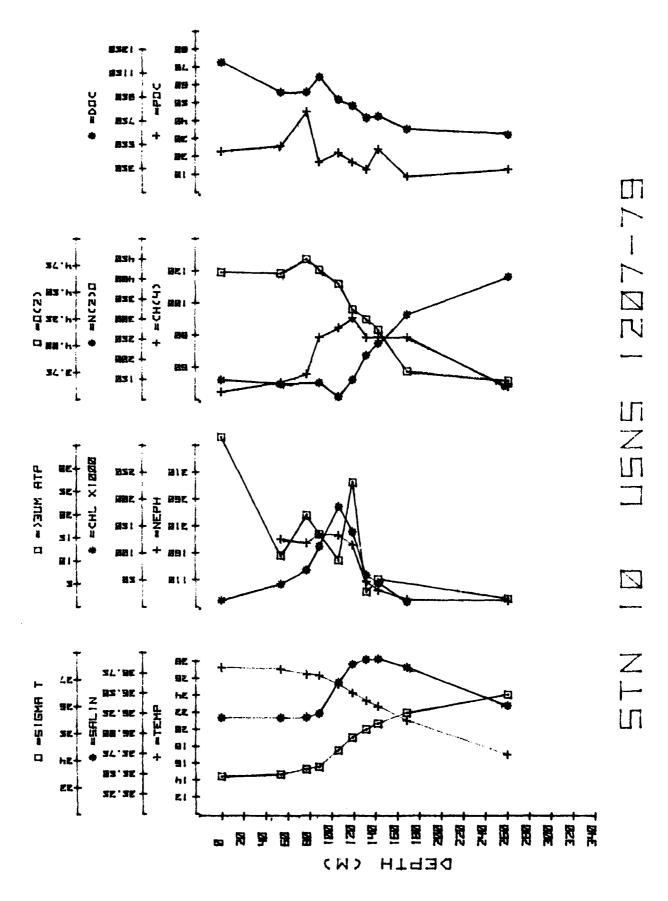
1.00
20.36
26.13
0.100
20.5
39
131
113
25.010
40 22.552 36.393 25.010
22.952
3

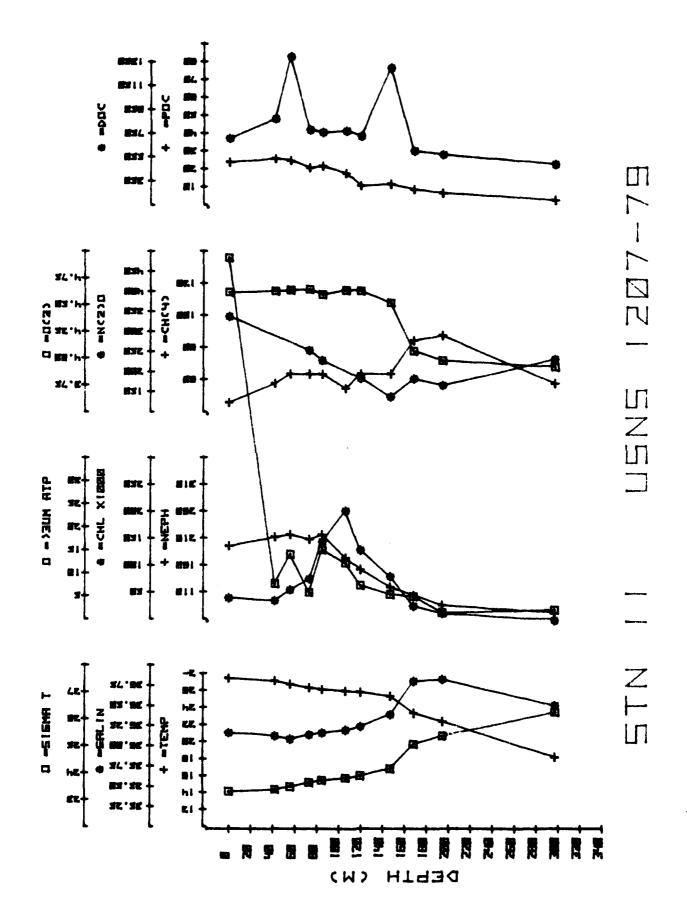
DEPTH PROFILES OF DATA

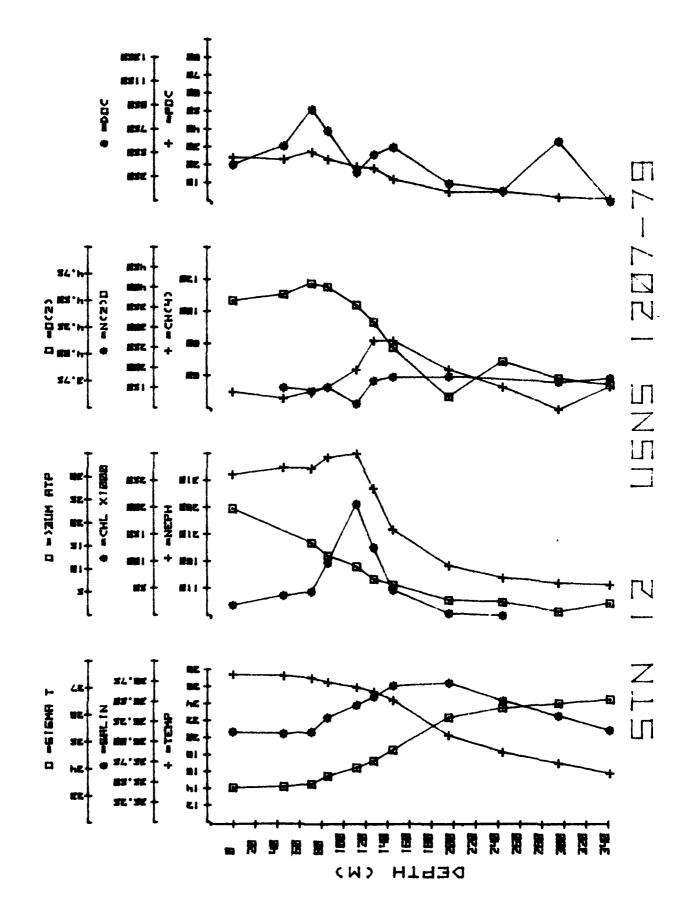
USNS DESTEIGUER 1207-79

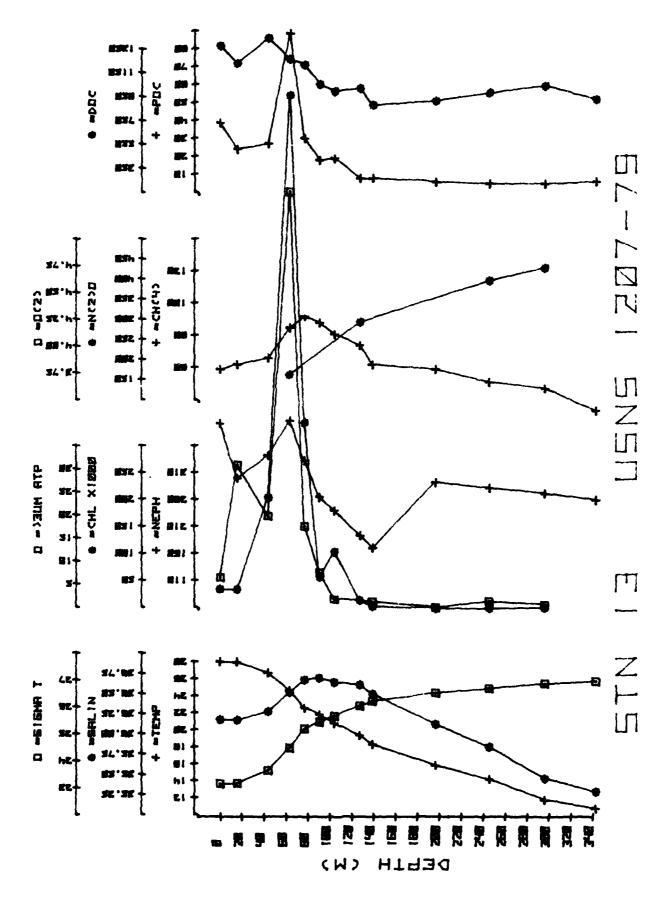
LEG II

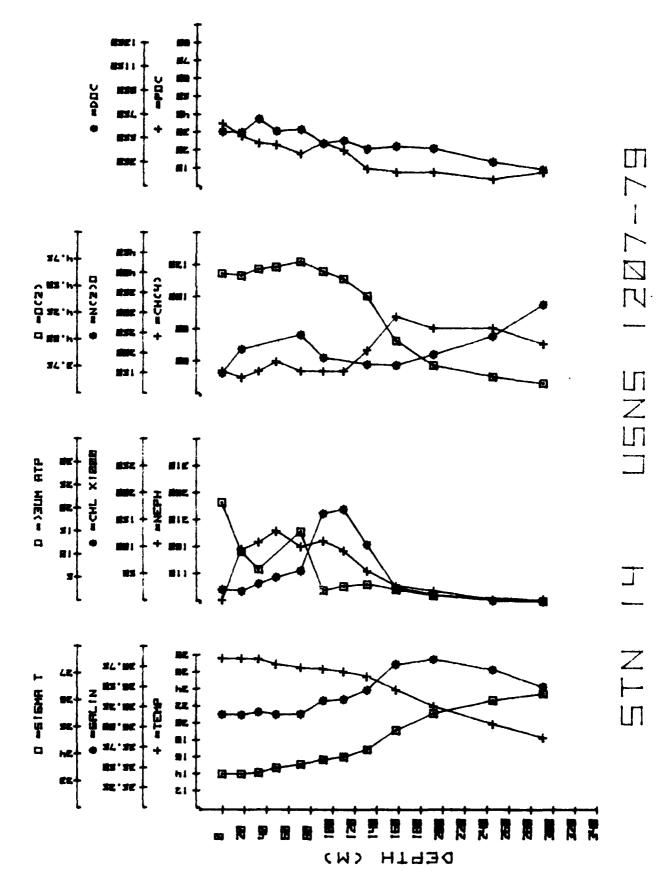
STATIONS 10 THROUGH 21

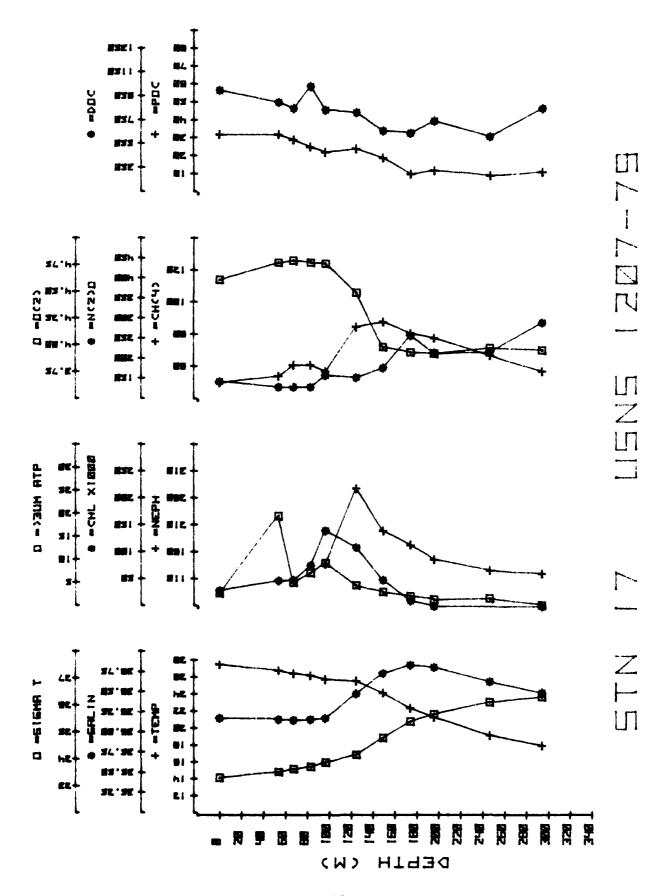


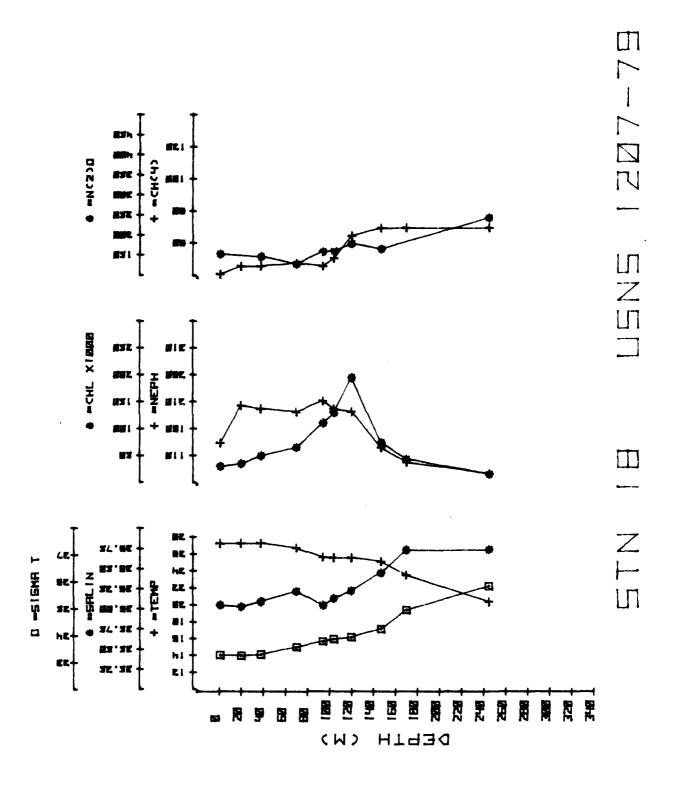


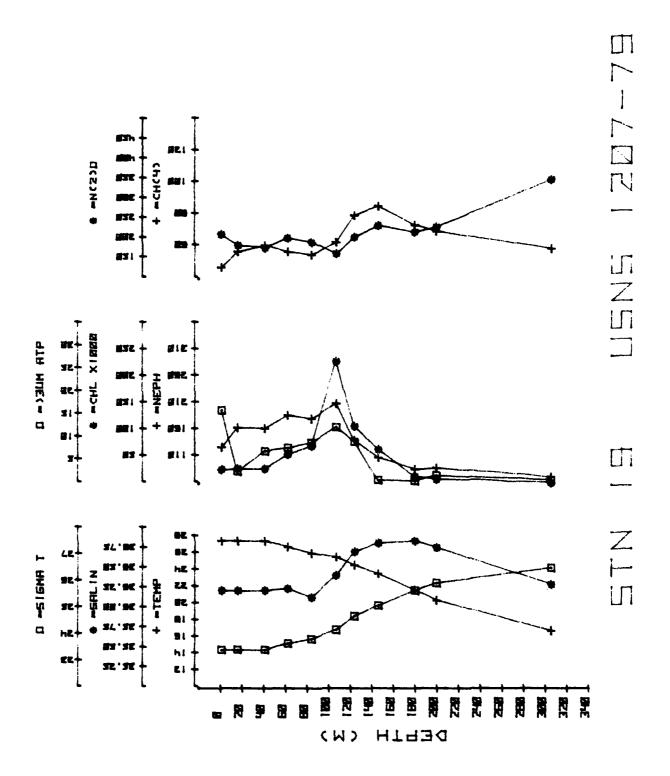


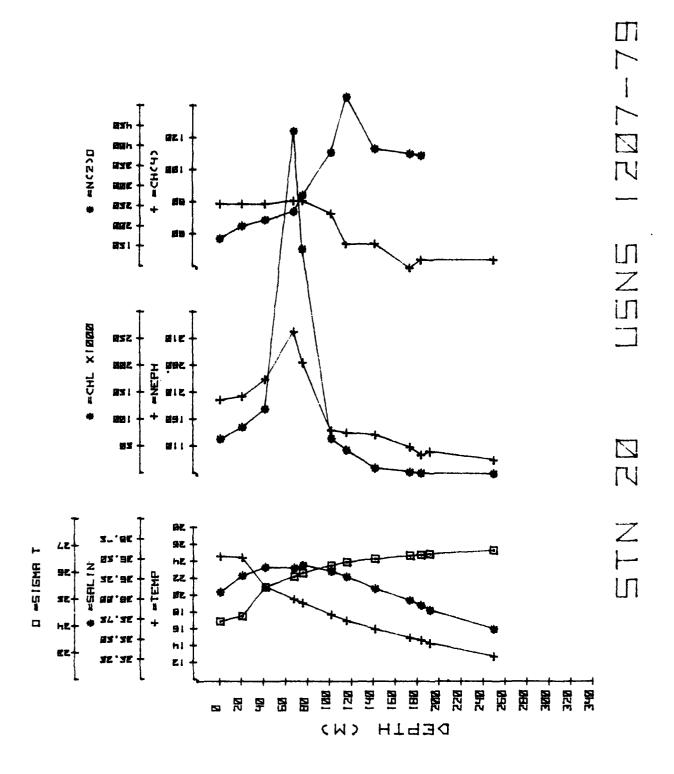




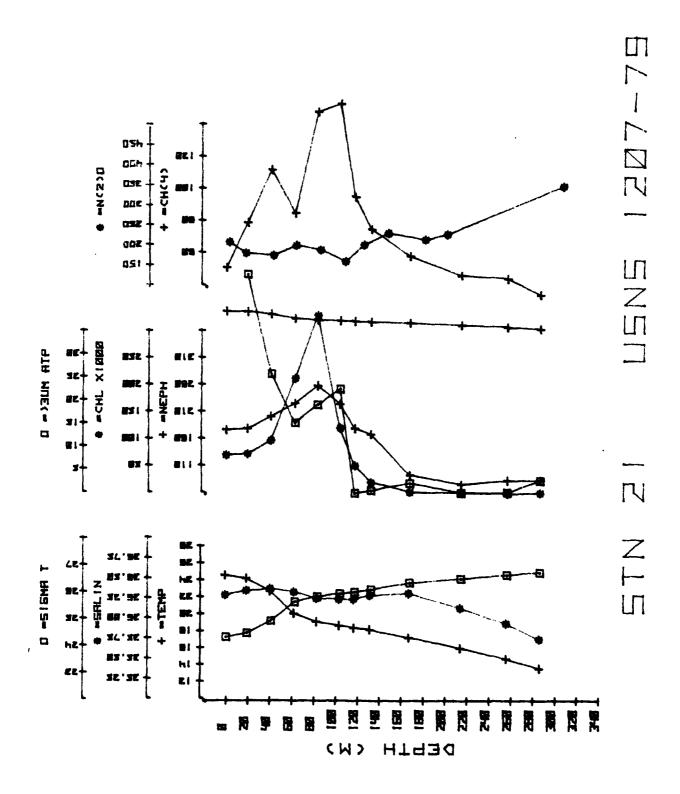








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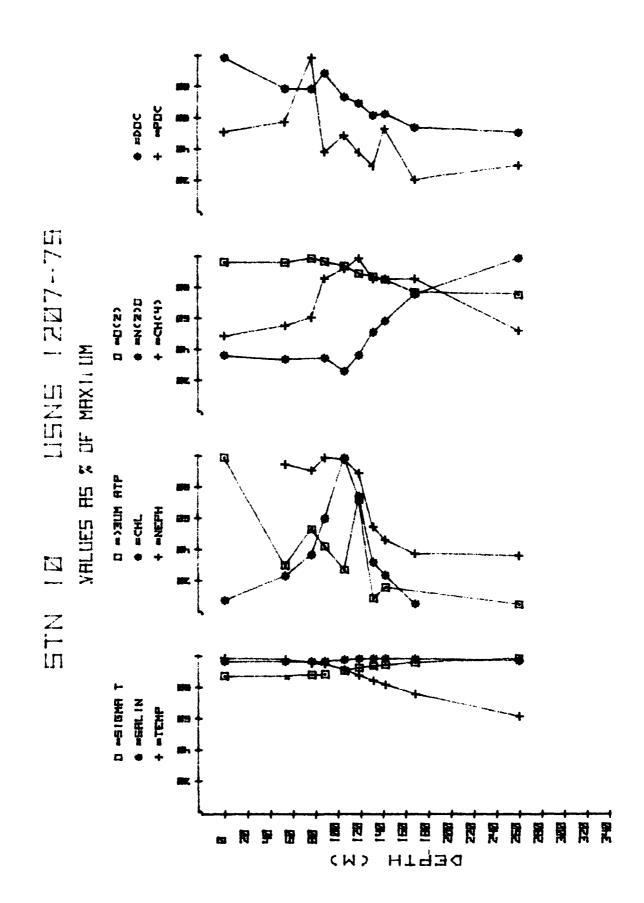


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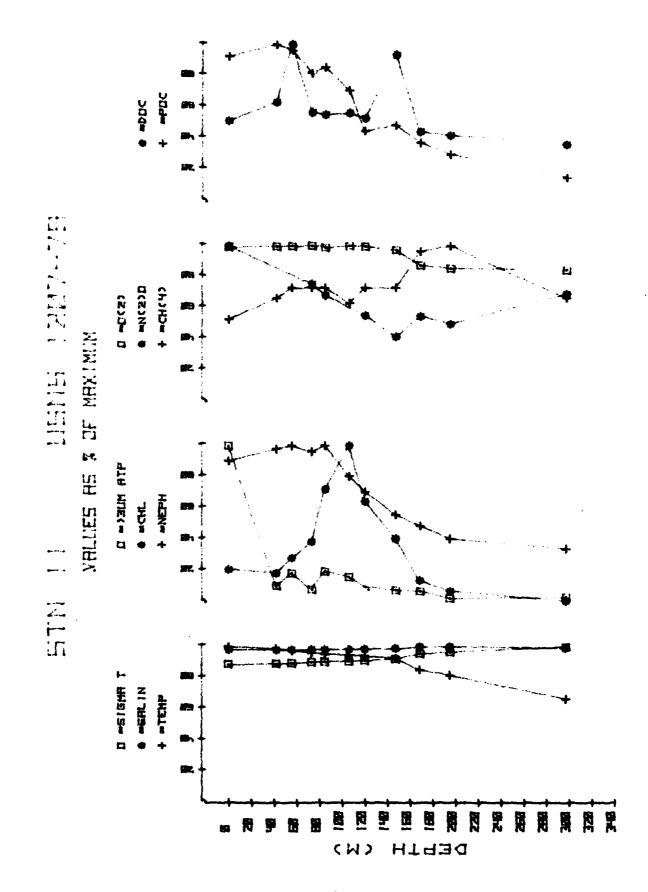
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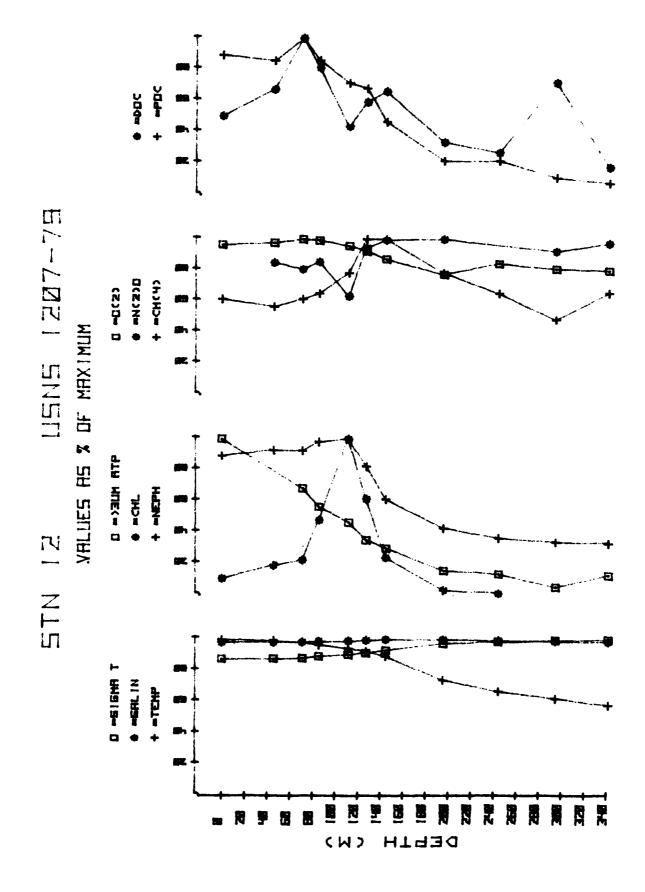
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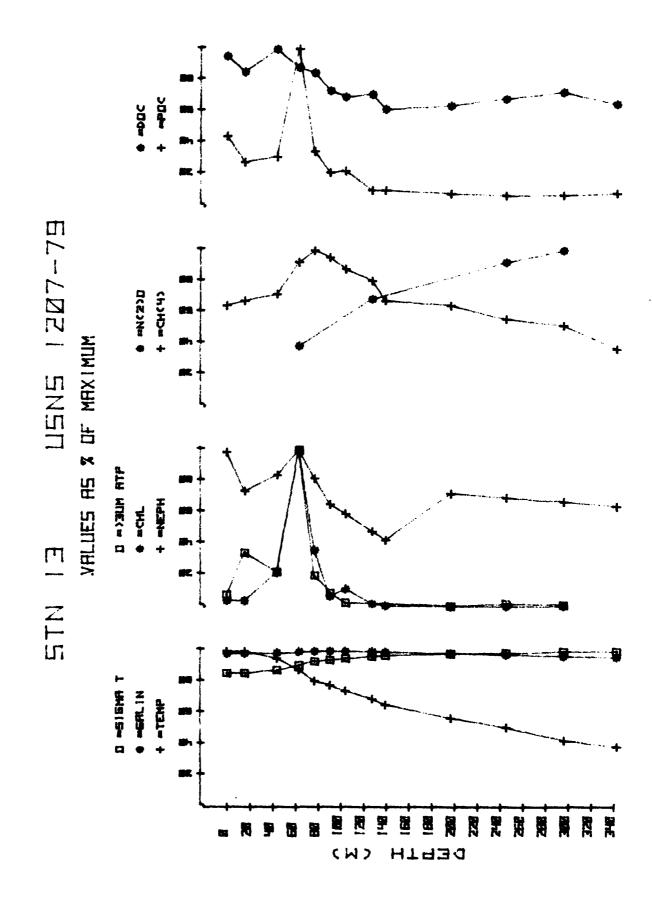
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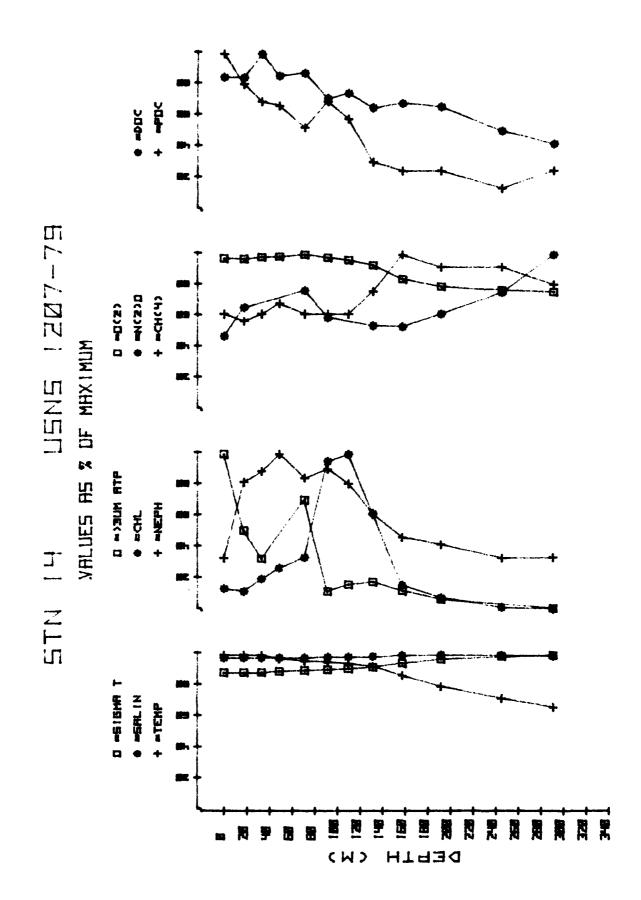


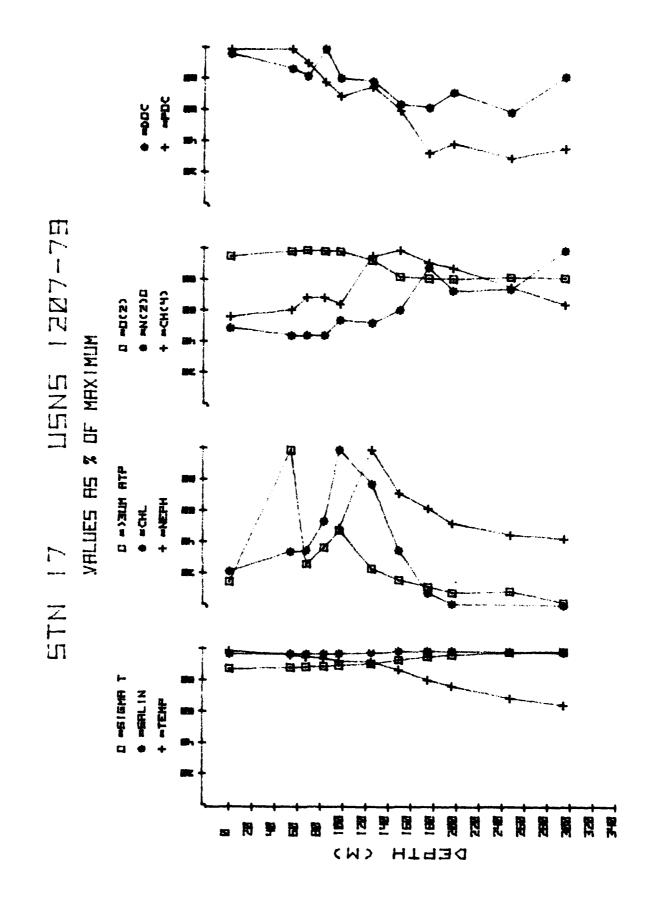
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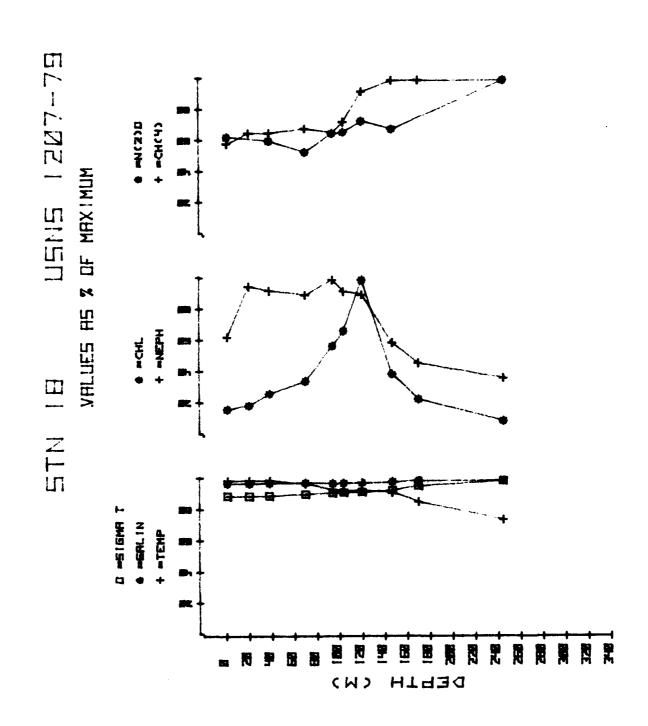


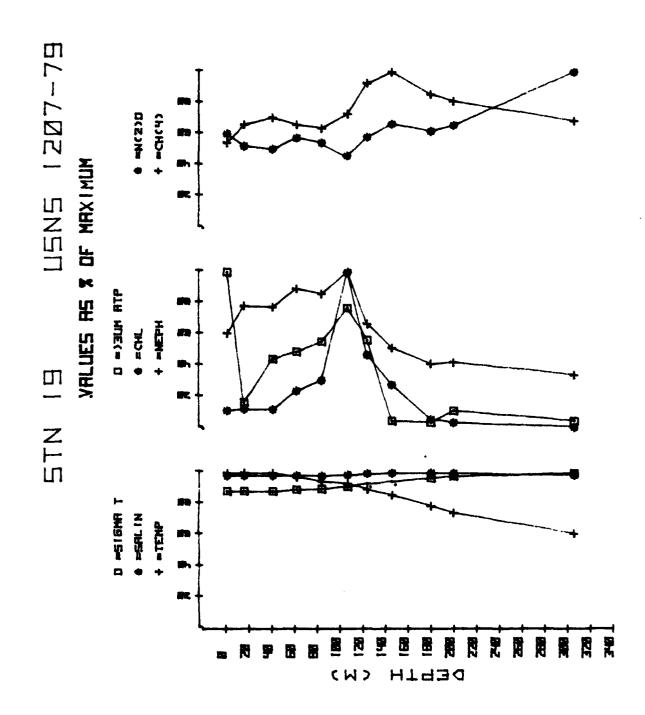
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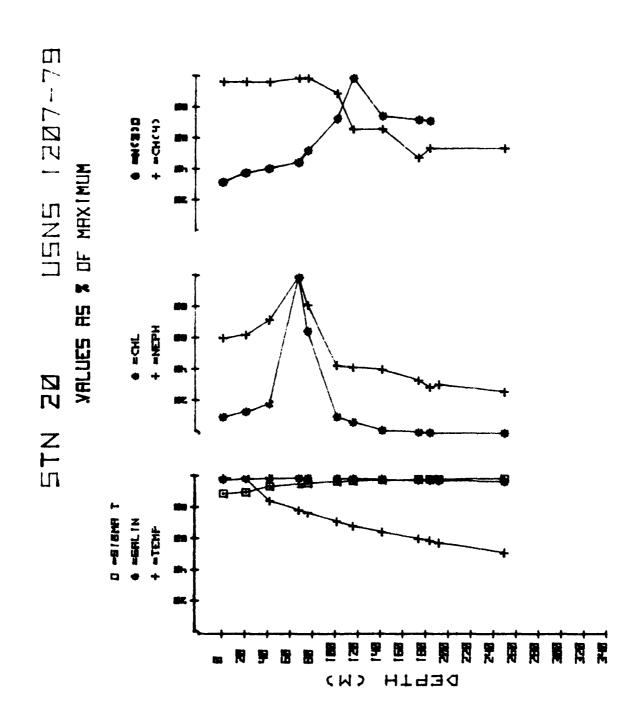


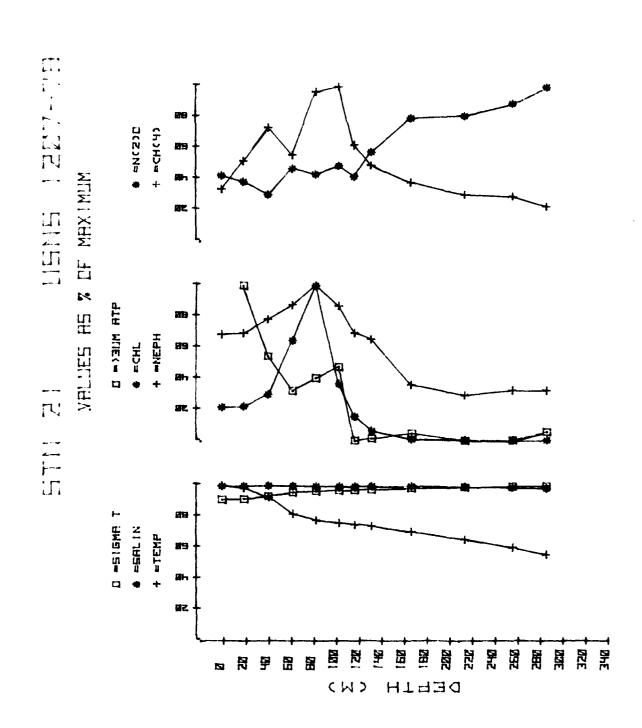


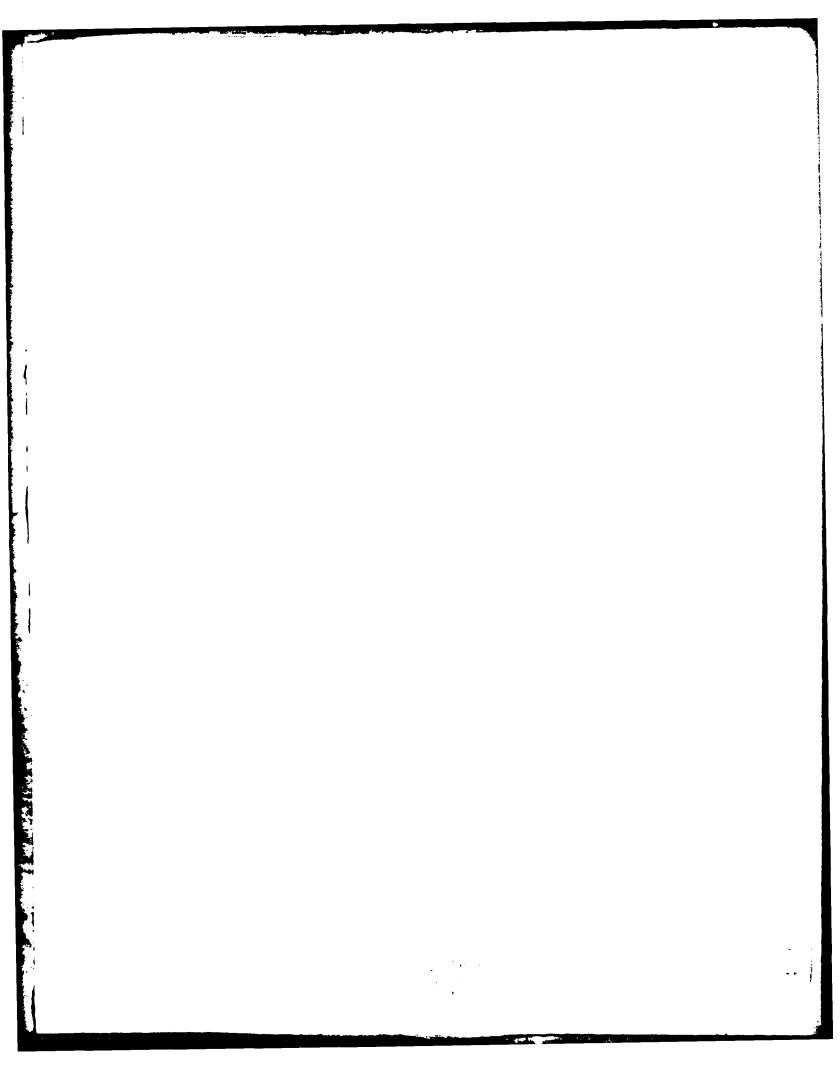




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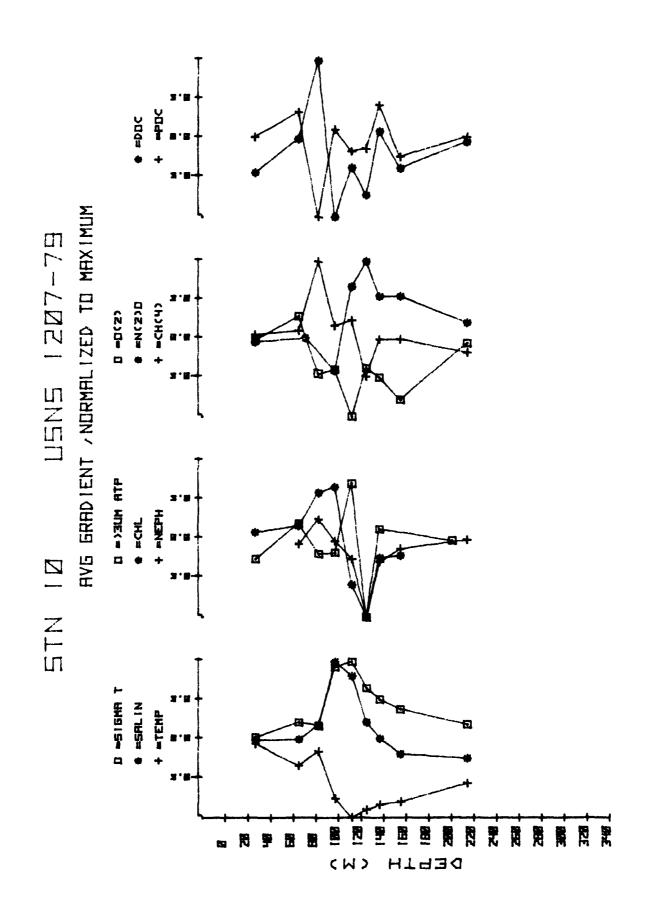


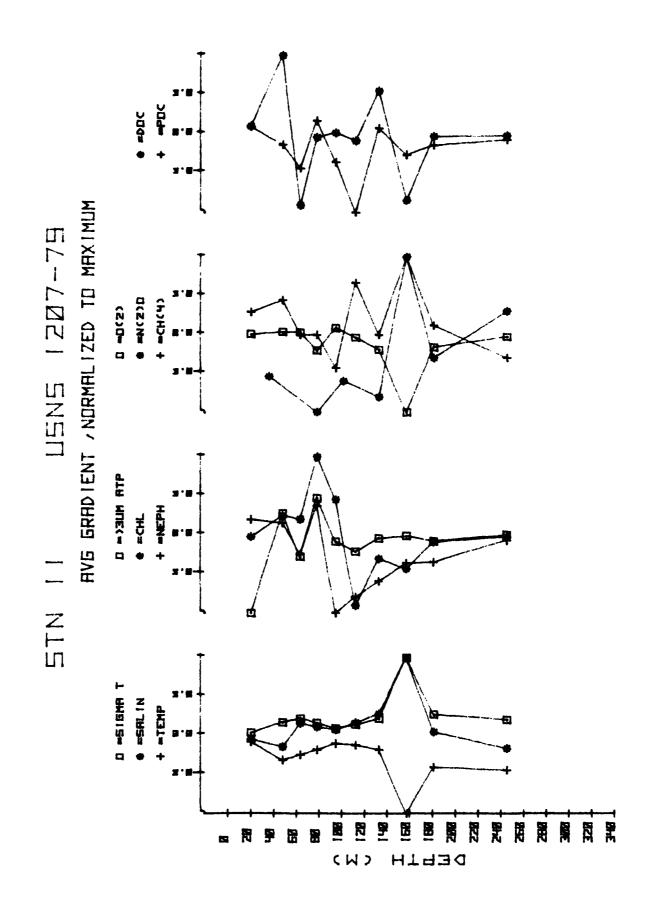
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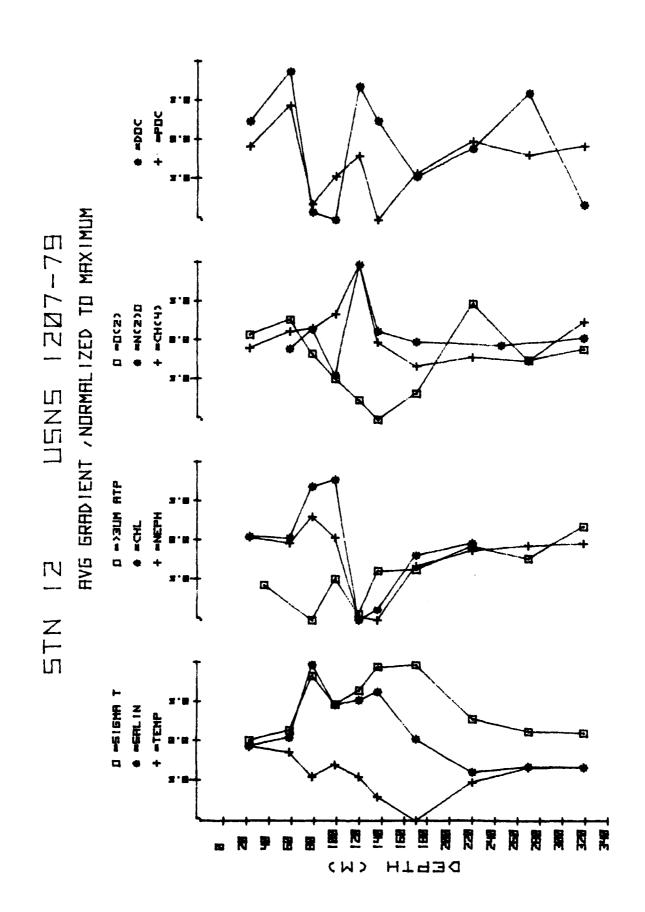
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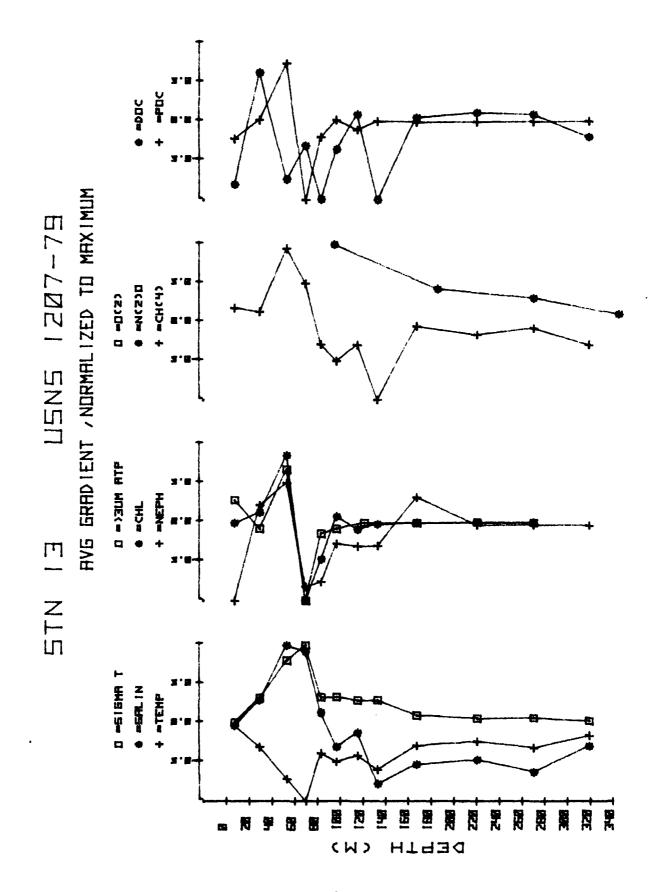
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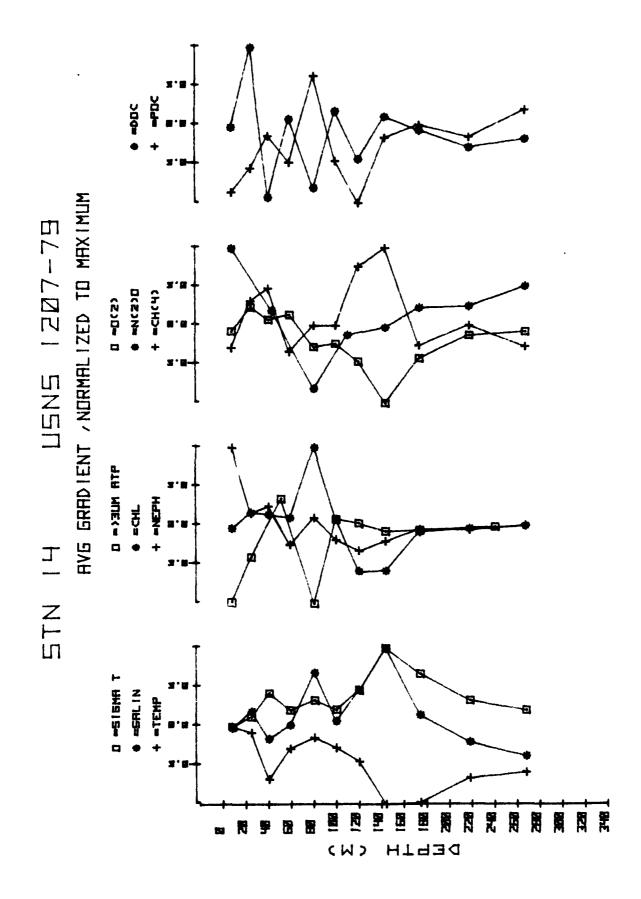


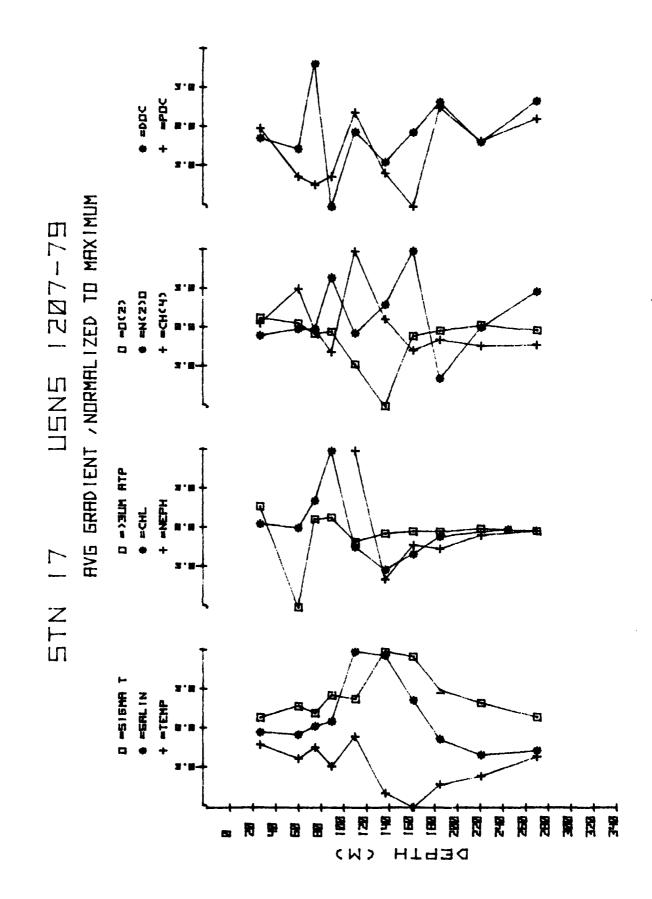




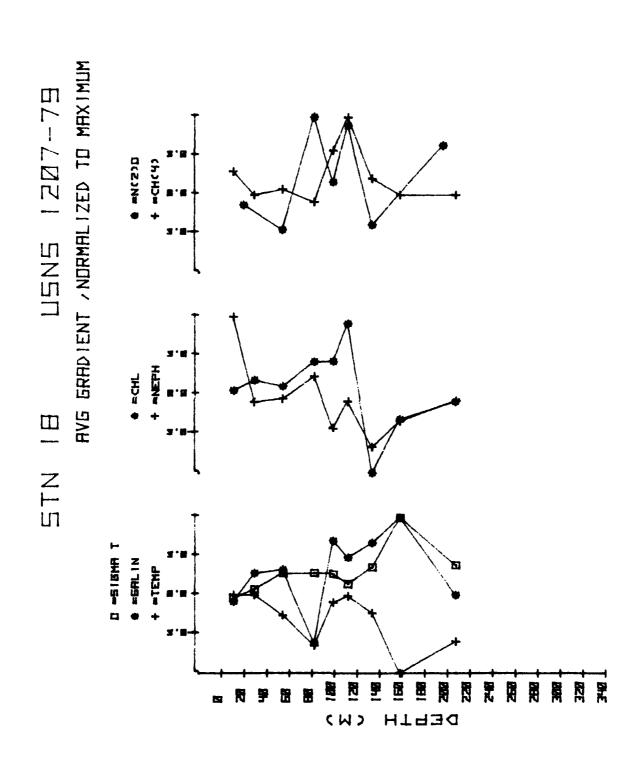
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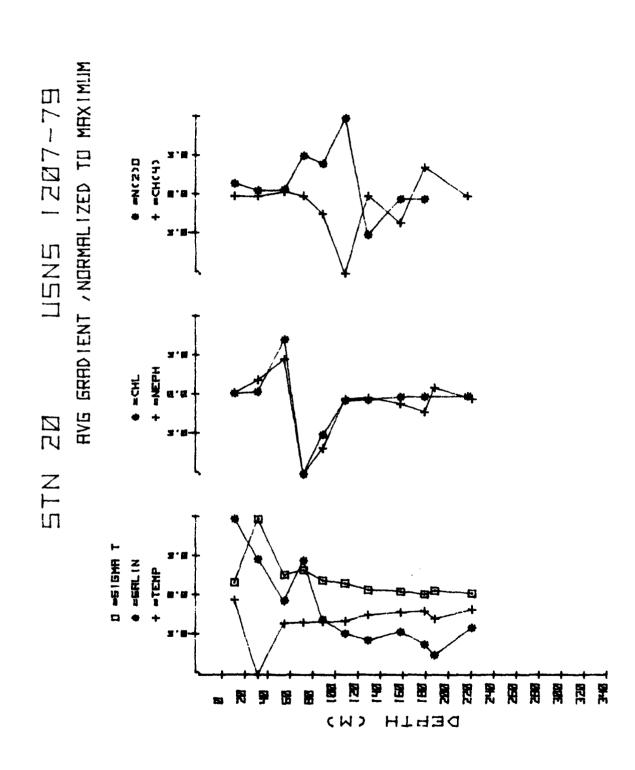


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# APPENDIX A: CRUISE AND LABORATORY PARTICIPANTS

Name	<u>Affiliation</u>	Principal Responsibility
Reid, David F.	NORDA	CTD/Chief Scientist
Brooks, James M.	TAMU	N <sub>2</sub> O, CH <sub>4</sub> /TAMU Project Leader
Sackett, W. M.	TAMU	N2O, CH4/TAMU Project Leader
ABD El-Reheim, H.	TAMU	Nutrients
Bodennec, G.	Centre' Oceano- logique de Bretagne (FRANCE)	N20, CH4
Burke, R. A.	TAMU	N20, CH4
DePalma, Irene P.	NORDA	Salinity, 0 <sub>2</sub> , TSM, ATP analysis
Hayes, Joe D.	NORDA	DOC, POC Laboratory Analysis
Kennicutt, M. C.	TAMU	DOC, POC Sample preparation
Lavoie, Dennis M.	NORDA	ATP Sample preparation
Turner, C. A.	NORDA	Chlorophyll sample preparation

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## APPENDIX 3: COLLECTION AND ANALYTICAL METHODS

## 1. CH4 and N20

Care was taken to prevent the introduction or trapping of air in the collection bottle by filling the bottle from the bottom using a piece of plastic tubing fitted to the Niskin bottle drain cock, by allowing the filled bottle to overflow, and by capping the collection bottle carefully. Analysis was begun immediately using the method of Brooks, Reid and Bernard (1981).

In its essentials, the method consists of first separating and concentrating the dissolved gases by bubbling pure helium through the sample in a closed purging loop. The purged gases are trapped in a tube containing a hydrocarbon adsorbant cooled by liquid nitrogen. Subsequently, the gases are released from the trap by heating and are flushed with helium through a gas chromatograph fitted with a flame ionization detector (for CH4) or an electron capture detector (for N20). Calibration is accomplished using standard gas mixtures; precision of the method is approximately 5.5% and the detection limit 0.2 nl/l. Single analyses were done for each gas at each depth.

# 2. 02

Calibrated 125 ml glass flasks were rinsed twice with the seawater sample, then gently filled from the bottom using a short length of plastic tubing attached to the Niskin drain cock. After allowing the flask to overflow copiously, a glass stopper having a conical end to displace contaminating air bubbles was inserted.

A modified ("Micro") version of the standard Winkler titration was used to analyze for dissolved oxygen (Carpenter, 1965; U. S. Naval Oceanographic Office, 1970). The tabulated values are the average of duplicate determinations.

#### 3. TSM

A separate hydrocast, consisting of twelve 30 liter Niskin bottles, was used to collect water for total suspended matter. These bottles were fitted with new rubber springs (to minimize the occurrence of rubber particles in the sample water) and with special taps threaded into the bottom edge to enable all the water to be drained. A short piece of plastic tubing connected each tap to a 47 mm diameter in-line filter holder (Nuclepore Corp., Pleasan-ton, CA); this in turn was connected to a "catch" jug which was maintained under continuous vacuum. Each filter holder contained a tared 0.4  $\mu m$  pore size Nuclepore filter.

Vacuum filtration of the seawater proceeded until either all the water was drained from the Niskin bottle or the filter clogged. Salt was removed from the filter by injecting 30 ml of filtered, distilled water into the filter holder and applying suction until the filter was dry. The filter was then placed in a 47 mm plastic culture dish (Millepore Corp., Bedford, MA), desiccated overnight, and sealed with tape. "Blank" filters were loaded, rinsed, unloaded and stored along with the test filters, but no seawater was passed through them. The volume of seawater passed through each filter was measured in the catch jugs using a calibrated dipstick. Loading and unloading

of the filter membranes from the holders was done in a down-draft, laminar-air-flow hood.

At the laboratory, the filter membranes were weighed to the nearest microgram on a digital Cahn Electrobalance (Cahn Instrument Co., Cerritos, CA). Although they load up more quickly, Nuclepore filters are readily washed of salts and are not subject to the hydration problems associated with membrane filters or the fraying problems of glass fiber filters. The polycarbonate filters do tend to be prone to electrostatic effects, but this problem can be controlled by maintaining moderate humidity (approx. 70%) and using an ionization source in the weighing chamber. Single measurements were made at each depth.

# 4. Organic Carbon

Preparation of materials and analytical procedures generally followed those of Strickland and Parsons (1972) with some modifications. Calibrated, 1 liter glass reagent bottles were rinsed and filled with the sample. Particulate and dissolved organic carbon fractions were obtained simultaneously with an in-line system: the sea water was drawn up a glass siphon tube placed in the sample bottle and through a precombusted 25 mm diameter glass-fiber filter (GF/C, Whatman Inc., Cliffton, NJ) mounted in a polycarbonate in-line holder (Nuclepore Corp.) attached to the top of the tube. The filtrate was then drawn into a 250 ml side arm flask from which it overflowed into the vacuum reservoir/waste receptacle. The filter was analyzed for particulate organic carbon (POC), and the filtrate remaining in the 250 ml flask was analyzed for dissolved organic carbon (DOC). Duplicate sample bottles were taken so that duplicate POC determinations could be made, and three replicate samples for DOC determinations were drawn by glass syringe from one of the 250 ml flasks. Reagents were added to the DOC ampules as per Strickland and Parsons (1972), but for the POC ampules, the glass-distilled water, persulfate and acid were premixed 8 hours before use for convenience and to minimize the reagent blank. This reagent solution was dispensed using an all-glass and Teflon Repipettor (Oxford Instruments Inc., Columbia, MD). The ampules were sealed using an Oceanography International Corporation (OIC, College Station, TX) Sealing/ Purging Unit and were packed for transport.

At the laboratory, the ampules were cooked at  $100\,^{\circ}\text{C}$  overnight to complete digestion of the organic material to  $\text{CO}_2$  and analyzed by infrared adsorption on an OIC Carbon Analyzer. Standards were run at the beginning and end of each sample set using oxalic acid dilutions prepared in ampules. The standard curve was best fitted by a quadratic equation to account for nonlinearity at the low end of the range of concentrations encountered. Blanks on standards and samples were run according to Strickland and Parsons (1972).

## Chlorophyll and Phaeopigment

Pigment samples were drawn into rinsed, calibrated 1 liter, brown plastic bottles, and filtered and stored according to Strickland and Parsons (1972). Duplicate samples of the total phytoplankton pigment were filtered at each depth.

The filters, stored at -20°C in a desiccator, were transported to the laboratory at the end of the cruise, and the pigments extracted by grinding and steeping in neutral 90% acetone approximately 4 to 6 hours. Chlorophyll

"a" and phaeopigment "a" were measured after Strickland and Parsons (1972) using a Turner Designs Model 000-10 Fluorometer (Turner Designs, Mountain View, CA).

### 6. ATP

Seawater was drained into rinsed, brown plastic, 250 ml and 500 ml bottles. Duplicate aliquots were drawn through 3  $\mu m$  pore size Nuclepore filters to recover particles larger than 3  $\mu m$ . In a separate filtration, duplicate 250 ml aliquots were drawn through 0.2  $\mu m$  pore Nuclepore filters to recover particles larger than 0.2  $\mu m$ . After extraction, the latter filters yielded a "Total" ATP estimate for all microorganisms in the water down to bacteria. The results from the first fraction were then subtracted from this value to derive a "<3  $\mu m$ " fraction. The ">3  $\mu m$ " fraction represents ATP contributions from microzooplankton, net phytoplankton, micro flagellates (also known as nanoplankton or ultraplankton), and bacteria on detrital or fecal particles. The "Total ATP" fraction includes all of these contributions + that of the bacterioplankton and the smaller microflagellates.

ATP was extracted from the particles on the filters by the standard method (Holm-Hansen and Booth, 1966): as soon as the last of the seawater passed through it, the filter was removed from the filter holder and plunged into 5 ml of boiling Tris buffer (tris hydroxyaminomethane at pH 7.8, 0.05 M) contained in a 20 ml scintillation vial and boiled for at least 3 minutes. Procedural blanks were obtained by extracting filters taken straight from the box.

The extracts and filters were cooled and frozen in the vials and maintained at -20°C until analysis at the laboratory, where they were gently thawed and brought to the original 5 ml volume with "low response" water (i.e., water purified by ion exchange and reverse osmosis, neutralized with NaOH, and tested for ATP activity). Analysis was accomplished by injecting 200 µl of sample into 100 µl of purified luciferin-luciferace system (DuPont Inc., Wilmington, DL). The resulting light emission was measured in a sensitive photometer (SAI Inc., San Diego, CA), after a 10 second delay, by integrating the area under the reaction decay curve for 30 seconds. From two to four injections were made of each extract, so that each data point represents a minimum of duplicate determinations on each of two replicate filtration/extractions. Standards were made with "low response" water and pure Na-ATP salt (Sigma Chem. Corp., St. Louis, MO). Both blank and unknown concentrations were normalized to 5 ml before correcting for the blank and extrapolating back to the seawater concentration.

#### 7. Nutrients

Samples were drawn into sterile Whirl Pak plastic bags (NASCO, Inc.) and kept at 4°C until processing, which was completed within six hours. Sample preparation followed Strickland and Parsons (1972) and analysis was performed using a Technicon Auto Analyzer (Technicon Instruments Corp., Tarrytown, NY).

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This report is a summary of data collected in the Western Caribbean and Gulf of		
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column were obtained for the following parameters: conductivity, temperature		
saimity, nephelometry, total suspended matter, dissolved and particulate		
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×	(1) tables of measured and derived parameters; (2) depth profiles of unnormalized values, normalized values, and normalized rates of change. Descriptions of the collection and analytical procedures are also given.
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